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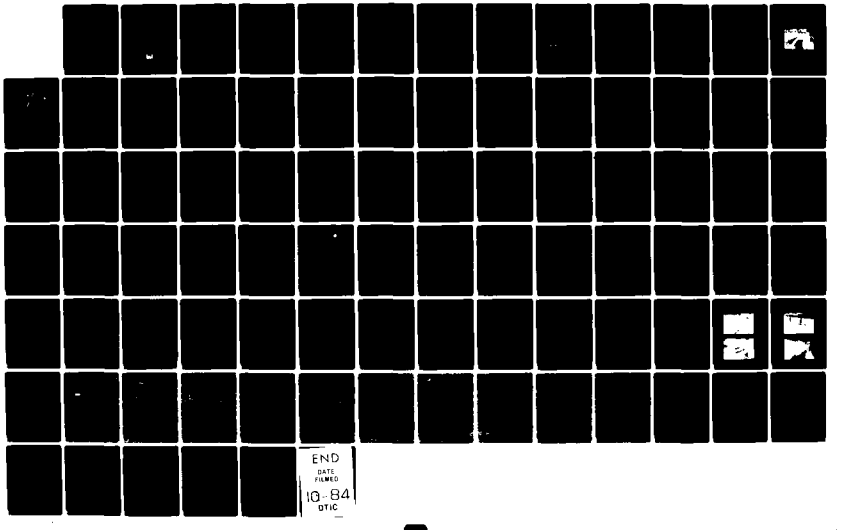

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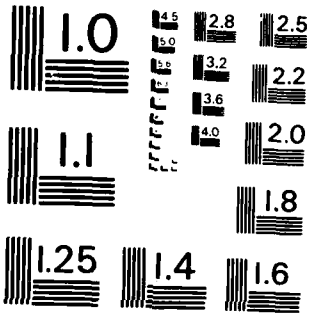

BLACKSTONE RIVER BASIN
WORCESTER, MASSACHUSETTS

QUINSIGAMOND POND DAM
MA 00139

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST 1978

UNCLASSIFIED

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Worcester, Mass.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Quinsigamond Pond Dam is an earthfill dam with an arched, stone masonry spillway. The dam and spillway is about 240 feet long and 18 feet high. The dam is considered to be in fair condition. In addition, the dam has been classified in the "high" hazard category. Based on size and hazard classification, the test flood is ½ the PMF.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED

JUN 18 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

I am forwarding to you a copy of the Quinsigamond Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Riley Stoker Company, P.O. Box 547, Worcester, Massachusetts 01613.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

QUINSIGAMOND POND DAM

MA 00139

BLACKSTONE RIVER BASIN
WORCESTER, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00139

Name of Dam: Quinsigamond Pond

Town: Worcester

County and State: Worcester County, Massachusetts

Stream: Middle River, a tributary of the Blackstone River

Date of Inspection: August 3, 1978

Quinsigamond Pond Dam is an earthfill dam with an arched, stone masonry spillway. The spillway comprises the major portion of the dam. An earlier dam was constructed at the site some time prior to 1833. The present spillway was built in 1891, and there were subsequent modifications to the embankment and outlets. The dam and spillway is about 240 feet long and 18 feet high. The spillway section, which is 155 feet long, has a cut-off wall of 4-inch sheeting that extends at least 10 feet into the embankment. There are two visible outlet gate structures in the south abutment area. One gate is inoperable and the other gate is reportedly still operable, although it has not been used in over 5 years.

Quinsigamond Pond Dam was neither designed nor constructed by current approved, state-of-the-art procedures. Based upon the visual inspection at the site and the limited engineering data available, there are areas of concern which must be corrected to assure the continued performance of this dam. Generally, the Quinsigamond Pond Dam is considered to be in fair condition. In addition, the dam has been classified in the "high" hazard category.

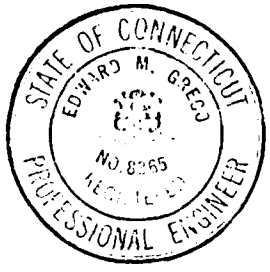
The following visible signs of distress indicate a potential hazard at the dam: heavy siltation upstream of the dam, resulting in the accumulation of weeds, brush and debris that seriously restricts spillway flow and reduces the storage capacity of the pond; the deteriorating condition of the flashboards; the growth of grass between the blocks of the face of the spillway; the missing gate stem at one outlet; trees growing on the embankment, and stonework missing from the north abutment of the spillway.

Hydraulic analyses indicate that the spillway can discharge a flow of 6,600 cfs at El 445.7, which is the low point of the dam. Based on size and hazard classifications in accordance with Corps guidelines, the test flood is one-half the maximum probable flood. The inflow test flood of 17,140 cfs, is adjusted for surcharge storage, resulting in an outflow of 17,075 cfs. This outflow will overtop the main dam by a maximum height of 3.1 feet. The spillway is inadequate since it can discharge only 38 percent of the test flood before the dam is overtopped. However, due to the regulating effect of the upstream flood control structure which was installed in 1959, it is unlikely that overtopping the dam is a serious hazard. However, it is recommended that a definite surveillance plan and warning system be developed for use during periods of unusually heavy rain or runoff, since overtopping could result in complete failure of the dam.

Further investigations to assess the adequacy of the dam are not considered necessary at this time. However, an analysis should be performed to determine the limits of dredging of soil upstream of the dam so that the stability and impermeability of the dam is unimpaired. For the present time, it is recommended that the Owner remove the remaining flashboards from the weir; dredge soil and vegetation from the area upstream of the spillway; repair the outlet works next to the south abutment of the spillway; clear trees and brush from the earth embankment; and replace the blocks missing from the wall at the north abutment. The Owner should also implement a systematic program of inspection and maintenance.

The recommendations and remedial measures described in Section 7 should be implemented by the Owner

within a period of one year after receipt of this Phase I Inspection Report. An alternative to these recommendations would be draining the pond and breaching or removing the dam. However, prior to breaching the dam all accumulated soil within the pond should be removed and disposed of offsite.



Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Connecticut Registration
No. 08365

Approved by:

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703

This Phase I Inspection Report on Quinsigamond Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr.

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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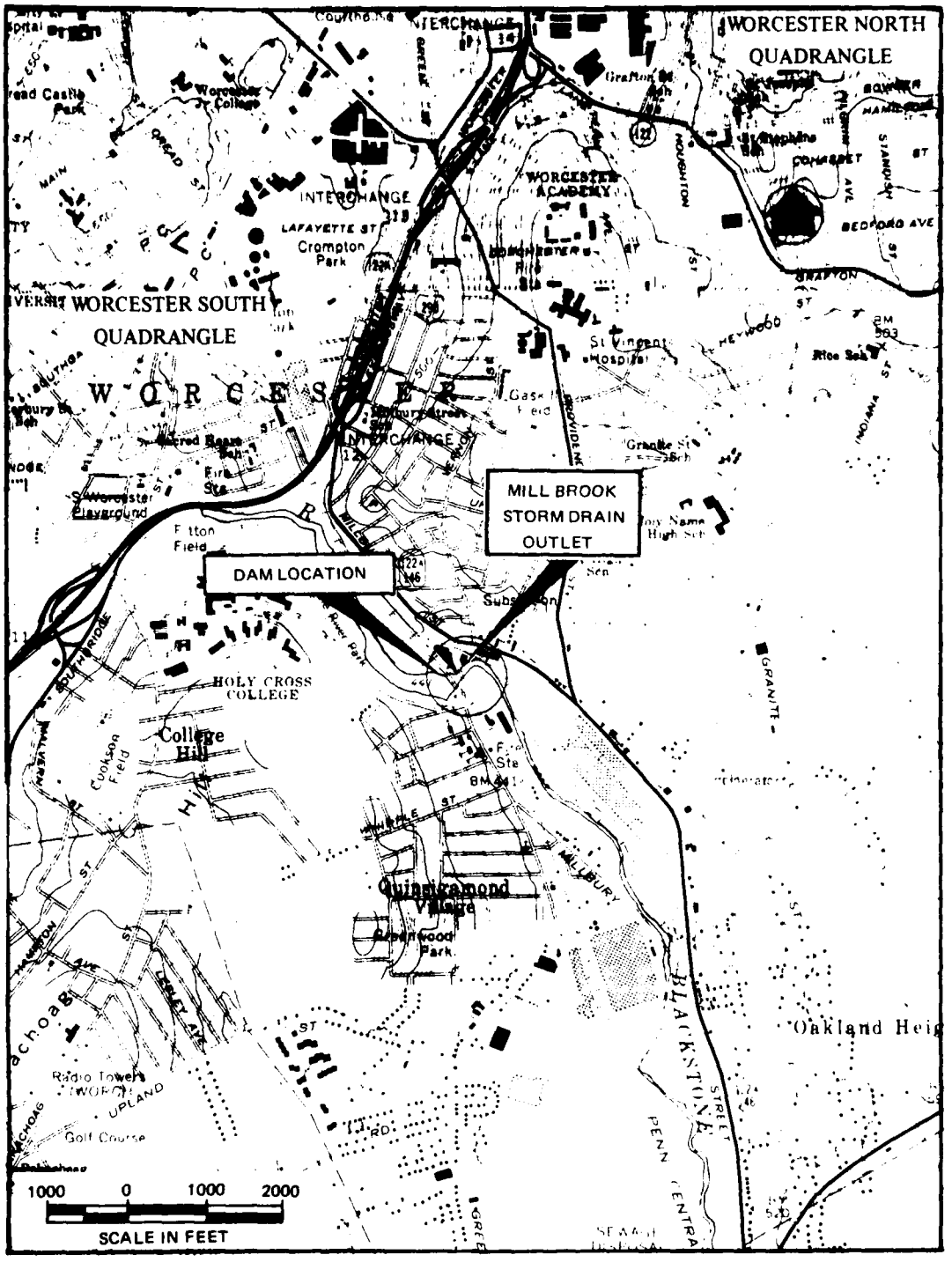
QUINSIGAMOND POND
WORCESTER, MASSACHUSETTS

VIEW FROM SOUTH ABUTMENT

Location and Direction of Photographs
Shown on Figure in Appendix B



LOCATION MAP - QUINSIGAMOND POND DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

QUINSIGAMOND POND

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Metcalf & Eddy, Inc. under a letter of May 3, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0306 has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on Middle River, a tributary of the Blackstone River, in the City of Worcester, Worcester County, Massachusetts (see Location Map, and Watershed Plan, Figure D-1).

b. Description of Dam and Appurtenances. Quinsigamond Pond Dam consists primarily of an arched, mortared stone masonry spillway with an earthfill embankment at the southern end. The dam and spillway are about 240 feet long and the dam has a maximum height of 18 feet. The spillway is 155 feet long and constructed of mortared stone blocks with a battered downstream face and a stepped upstream face (see Figure B-3). Drawings indicate that there is a cutoff of wood sheeting beneath the spillway wall 3 feet from the upstream face. This sheeting is shown to extend laterally at least 10 feet beyond the ends of the spillway. The crest of the dam is comprised of granite cap blocks 5.4 feet wide, and varies from El 440.8 to 441.2. Flashboards 1.8 feet high are mounted with steel pins on the northern 90 feet of the crest. The flashboards have collapsed along the southern portion of the crest. The top of the flashboards varies from El 442.6 to 443.0. Sidewalls of the spillway are constructed of mortared stone and are 4.7 feet (south end) to 4.9 feet (north end) above the crest. Drawings indicate that the toe of the dam has been protected by a 12-foot-wide apron, constructed of concrete and covered with wood planking. At the downstream edge of this apron is another cutoff of wood sheeting. The spillway discharges into a recessed channel 165 feet wide with vertical, mortared stone walls 12.5 feet high.

The crest of the earth fill embankment at the south end of the spillway is irregularly

shaped and is at an approximate elevation of 445.5. The upstream face of the dam is a vertical, mortared stone wall. The downstream face has been filled in approximately level with the crest to construct a road and railroad tracks. A locked chain-link fence is along the crest and Greenwood Street to prevent access to the outlet structures.

There are two known outlet structures for the dam. One, located at the south abutment of the spillway, is a 6-foot-long, mortared stone sluiceway controlled by a 6-foot by 5-foot slide gate. This gate is operated by a rack and pinion mechanism mounted on grating. The wooden portion of the gate stem is missing and the gate is inoperable. The invert elevation of this outlet is 433.4, and it discharges at the downstream face of the spillway abutment.

A second outlet is located 66 feet south of the spillway, near the abutment of the dam. It is a concrete sluiceway controlled by a 4-foot by 3-foot slide gate. The gate, which is reportedly operable, can be regulated by a rack and pinion mechanism mounted on the headwall of the conduit. The outlet was used to provide water to a U. S. Steel factory. The length and discharge point of this outlet are unknown. There is also evidence of two other abandoned outlets within the pond. There is no information available on these outlets.

c. Size Classification. Quinsigamond Pond Dam is classified in the "small" category since it has a maximum height of 18 feet and a maximum storage capacity of 180 acre-feet.

d. Hazard Classification. Downstream of the dam is a heavily industrialized area, including several large factories and bridges for a railroad, Greenwood Street, and Millbury Street. In the event of overtopping and complete failure of the dam, more than a few lives could be lost and extensive property damage could occur. Accordingly the dam has been classified in the "high" hazard category.

e. Ownership. The dam is located on property owned by Riley Stoker Company, P. O. Box 547, Worcester, Massachusetts 01613. Mr. Tom Kennedy (617-852-7100 ext. 234) granted permission to enter the property and inspect the dam. Prior to February 1973 the dam and water rights were owned by U. S. Steel Corporation.

f. Operators. There are no known operators of this dam. The outlet structures are inside a 5-foot-high, locked chain-link fence, and the Riley Stoker Company has the key.

g. Purpose of Dam. Until 1973, the dam provided water for industrial purposes at a steel mill. It used to be called "South Works Pond" and, in 1947, supplied 18.7 million gallons of water per day to the American Steel and Wire Company (see listing of ponds in Figure D-1). The dam has not been used since 1973, and now serves indirectly for flood control.

h. Design and Construction History. An earlier dam was constructed at the site of the present dam some time prior to 1833. There are no drawings available that show its construction. The existing spillway section of the dam was built about 1891 (see Figure B-3). At that time, the dam was owned by the Washburn & Moen Manufacturing Company. Some time between 1891 and 1947, the dam became the property of American Steel & Wire Company, a subsidiary of U. S. Steel Corporation, which owned the dam until 1973.

Previous inspection reports indicate that the flashboards were in place and the outlet gates were in use as early as 1925.

In 1936, the dam was repaired and the earth embankment and a cut off of wood sheeting were extended 36 feet (see note on inspection listing, page B-4). In 1945, an inspection report stated that a "new concrete headwork" had been constructed for the outlet gate near Greenwood Street.

i. Normal Operating Procedure. There are no operating procedures at the dam. There are two known outlet structures controlled by slide gates located near the south end of the dam. The outlet next to the spillway is missing the wooden portion of the gate stem and is inoperable. The outlet next to Greenwood Street is reported to be operable, but has not been opened in over five years. There is also evidence of two other abandoned outlets within the pond. There is no information available on these outlets.

The spillway for Quinsigamond Pond Dam is ungated. Sections of the existing flashboards have collapsed and a major portion of the pond near the spillway is filled with silt. Normal flows are restricted to about 40 percent of the length of the crest.

1.3 Pertinent Data

a. Drainage Area. The approximately 40,300 acre (63 square mile) drainage area includes the basins of Ramshorn Brook, Dark Brook, Tatnuck Brook, Kettle Brook, and Middle River. About 25 dams are located upstream of Quinsigamond Pond, and seven of these reservoirs are used for water supply. Runoff from approximately 11.3 square miles of the area directly tributary to Quinsigamond Pond is diverted by the City of Worcester drainage system (Mill Brook Storm Drain) and discharged downstream of the dam into the Blackstone River. This results in a drainage area of 51.7 square miles directly tributary to the pond. A diversion tunnel is also located on Kettle Brook and conducts flood water downstream of Quinsigamond Pond Dam.

The drainage area is about 50 percent rural and 50 percent urban. Rural areas are sparsely populated, generally wooded, and have gentle to steep slopes. Urban areas are moderate to densely populated, with few wooded areas, and have flat to moderate slopes.

Discharge from Quinsigamond Pond Dam is to the Blackstone River, located directly downstream. The downstream area is a heavily developed, industrial and commercial section of Worcester.

b. Discharge. Normal discharge is over the spillway which is ungated. The spillway weir is about 155 feet long, and the crest elevation varies from 440.8 to 441.2. Wooden flashboards 1.8 feet high are mounted on the northern 90 feet of the crest. Water drops about 8 feet vertically into a downstream channel which is 165 feet wide with vertical stone sidewalls 12.5 feet high. Three granite block piers that support a railroad bridge are located 20 feet downstream of the dam. Two concrete piers that support the Greenwood Street bridge are located 115 feet downstream of the dam. The channel has a downstream slope of less than 1 percent and narrows to 100 feet wide at 500 feet below the dam. At that point, the channel makes a 90 degree turn to the right and continues in a southeasterly direction.

The spillway can discharge an estimated 6,600 cfs at El 445.7 which is the low point of the dam. The inflow test flood, which has been adjusted for water diverted to the Worcester Diversion Tunnel and Mill Brook Storm Drain, is 17,140 cfs and will overtop the dam by a maximum of 3.1 feet.

The maximum flood level at the dam is unknown. County personnel recall that the dam was not overtopped in 1936 or 1955; however, a 1936 flood level of El 447 is shown on the list of inspections (see page B-4). This is 1.5 feet above the lowest point on the crest of the dam.

c. Elevation [feet above Mean Sea Level (MSL)]. A benchmark at El 441.0 was established at the spillway crest. This elevation was estimated from a U.S.G.S. topographic map.

(1) Top dam: 445.7 to 446.2

(2) Test flood pool: 448.8

(3) Design surcharge (original design): unknown

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 441.0

(6) Spillway crest (ungated): 441.0

(7) Upstream portal invert diversion tunnel (Worcester Diversion): 487.0 (upstream diversion spillway crest elevation: 492)

(8) Stream bed at centerline of dam: 433.3 at top of downstream apron

(9) Maximum tailwater: 441.7 at test flood

d. Reservoir

(1) Length of maximum pool: 4,500 feet

(2) Length of recreation pool: 4,500 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge: 80 at El 445.7

(2) Top of dam: 180

(3) Flood control pool: N/A

(4) Recreation pool: 100 (Approximate)

(5) Spillway crest: 100

f. Reservoir Surface (acres)

*(1) Top dam: 17

*(2) Test flood pool: 17

(3) Flood-control pool: N/A

(4) Recreation pool: 17

(5) Spillway crest: 17

*Based on the assumption that the surface area will not increase significantly with changes in reservoir elevation from 441.0 to 445.7.

g. Dam

(1) Type: earthfill

(2) Length: 240 feet

(3) Height: 18 feet

(4) Top width (earth embankment at south end of spillway): varies from 10 to 35 feet

(5) Side slopes: upstream - vertical, downstream - filled to street grade

(6) Zoning: Unknown

(7) Impervious core: 4-inch timber sheeting

(8) Cutoff: 4-inch timber sheeting in concrete

(9) Grout curtain: Unknown

i. Spillway

(1) Type: Narrow crest

(2) Length of weir: 155 feet

(3) Crest elevation: 441.0 MSL (assumed benchmark)

(4) Gates: None

(5) Upstream channel: stone masonry sidewalls along pond

(6) Downstream channel: 12-foot-wide concrete apron at downstream toe. Leads to 165-foot-wide channel with vertical masonry walls 12.5 feet high.

(7) General: Downstream railroad bridge 25 feet from dam - then culvert under Greenwood Street, to stream channel with mortared masonry sidewalls. Channel takes 90 degree bend to southeast about 500 feet from dam.

j. Regulating Outlets. There are two known regulating outlets at the dam. One is located at the south abutment of the spillway. It is a 6 foot long, mortared stone sluiceway which is controlled by a 6- by 5-foot slide gate. This outlet is missing the wooden portion of the gate stem and is inoperable. The second outlet is near the abutment of the dam, and closer to Greenwood Street. It is a concrete sluiceway controlled by a 4-foot by 3-foot slide gate. The gate, although reportedly still operable, has not been used in over 5 years. There is also evidence of two other abandoned outlets within the pond. There is no information available on these outlets.

SECTION 2

ENGINEERING DATA

2.1 General. The only plans, specifications, or computations available from the Owner or State or County offices relative to the design, construction or repair of this dam is a "Plan of Dam Across the Blackstone River" filed in July 28, 1891. This plan shows details of the spillway weir, the concrete apron at the downstream toe, and two cutoff walls. A copy of this plan is included in Figure B-3 in Appendix B.

Supplementary information for the hydraulic-hydrologic evaluation for the dam was provided by U. S. Army Corps of Engineers "Design Memorandum No. 1" dated August 1975 for the Worcester Diversion. Three plans for this tunnel and the control dam were provided by the Corps, but were not included in this report. The only other data available for this evaluation were visual observations during inspection, review of previous inspection reports, and conversations with the Owner and with personnel from the State, County, and City agencies.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Iagallo.

Also, we acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole, Joseph Brasauskas, and Mr. Wallace Lindquist - recently retired from county service.

In addition, we thank Mr. Thomas M. Kennedy of the Riley Stoker Corporation, Owner of the dam, who gave permission to inspect the dam and provided access to the outlet structures.

2.2 Construction Records. The only construction record is the 1891 Plan referred to in section 2.1 and included in Appendix B. There are no as-built drawings for the dam, spillway and outlet structures.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation.

a. Availability. Due to the age of this dam, there is limited engineering data available.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection, past performance history, and sound engineering judgment.

c. Validity. The limited engineering data available is considered valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I inspection of the dam at Quinsigamond Pond was performed on August 3, 1978. A copy of the inspection checklist is included in Appendix A. Periodic inspections of this dam by others have been made since 1925. A partial listing of these inspections is in Appendix B. An inspection was made in 1973 by personnel of the Massachusetts Department of Public Works. Copies of those reports are also in Appendix B.

b. Dam. The dam consists of a stone masonry spillway with an earthfill embankment at the southern end. The earthfill embankment includes the outlet structures. The embankment is generally in fair condition. The downstream slope has been filled in to street grade. The upstream face is a vertical cut stone wall that appears to be in fair to good condition. The crest of the embankment is covered with grass and brush, and a few stones. A large tree is growing on the south abutment, outside the chain-link fence surrounding the outlet structures. The only visible concrete structure is on the embankment in the area of the outlets.

At the north abutment of the dam, stone blocks are missing from the top of the wall. Surface runoff flows into the pond immediately upstream of the weir.

c. Appurtenant Structures. The spillway is an arched, mortared stone structure located at the north end of the dam. Flashboards are mounted on the northern 90 feet of the crest. Upstream of the spillway there is a major accumulation of soil, vegetation, and debris. The upstream face of the spillway, which was originally constructed with stepped stone blocks, is now entirely silted in almost to the crest. The silt supports vegetation and seriously impedes the flow. This problem is particularly acute in

the area directly upstream of the section of the spillway which has flashboards. The deposition of silt and dense growth of weeds have built up the pond bed above the crest of the weir.

The flashboards have collapsed from the southern 65 feet of the crest of the spillway, and water is flowing over the weir. A broken piece of flashboard suspended by one pin remains in this section.

The stonework on the spillway is in good condition, although grass is growing between the blocks on the face of the weir, and on the sidewalls.

Two outlets which are located at the south abutment of the dam are surrounded by a locked chain-link fence. The channel nearest the spillway is in poor condition. The approach channel and intake are submerged, and the stone masonry sidewalls and concrete headwall of the outlet structure appear to be in fair condition. The wooden parts of the gate stem are missing, however, making the gate inoperable. There is a thick growth of shrubbery on top of the outlet structure. The outlet channel which connects with the spillway channel appears to be clear of debris.

The second outlet is closer to Greenwood Street, and was used to provide water to the former steel mill. The concrete of the sluiceway is in fair condition, with minor spalling and erosion evident, but no staining. The Owner reports that the gate is still operable. The downstream outlet channel is not visible. There is also evidence of two other abandoned outlets within the pond.

d. Reservoir Area. Quinsigamond Pond is bounded on the west by Middle River Park, and beyond that by Holy Cross College on College Hill. The rest of the pond area is surrounded by highly urbanized sections of Worcester, including a number of factories downstream. At the upstream end of the pond, the Middle River flows under I-290 before discharging into Quinsigamond Pond.

e. Downstream Channel. The discharge from the spillway flows in the stream channel under the railroad bridge and Greenwood Street, and into the Blackstone River. The channel has vertical mortared stone sidewalls for at least 500 feet below the dam, where it makes a 90 degree bend to the southeast.

3.2 Evaluation. The above findings indicate that there are areas of concern at the dam which require attention. It is evident that the dam is not adequately maintained and that deterioration will continue unless action is taken. Recommended measures to improve these conditions are stated in Section 7.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. There are no operating procedures at Quinsigamond Pond Dam.

4.2 Maintenance of the Dam. The dam is not adequately maintained. Silt, debris and vegetation have been allowed to accumulate in the pond and approach to the spillway. This condition has been of major concern as noted on previous inspection reports since 1938. Also, the growth of trees and brush on the embankment and between the stone blocks of the upstream walls has not been controlled.

4.3 Maintenance of Operating Facilities. One of the outlets at the south end of the spillway is inoperable. The slide gates are closed and cannot be opened with the existing mechanism. It is reported that the other outlet is operable.

4.4 Description of Any Warning Systems in Effect. There are no warning systems in effect at this dam.

4.5 Evaluation. There are no operational, maintenance, or warning systems in effect at Quinsigamond Pond Dam. This is extremely undesirable considering the fact that it is in the "high" hazard category. A program of operation and maintenance for this dam should be implemented as recommended in Section 7.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data. The Probable Maximum Flood (PMF) rate was determined to be 850 cfs per square mile. This rate was determined based upon the U. S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates, dated December 1977, modified to show the calculated peak flow rate for Leesville Pond (MA 00141) and extrapolated to different tributary areas.

The total drainage area to Quinsigamond Pond Dam was calculated to be approximately 63 square miles, and includes the tributary drainage areas for Leesville Pond (32.1) Coes Reservoir (10.9), Curtis Ponds (1.2), and the 18.7 square miles of area contributing directly to Quinsigamond and comprising most of urban Worcester. The Mill Brook storm drain, which discharges just downstream of Quinsigamond Pond, collects drainage from 11.3 square miles of the City of Worcester. Subtracting this diverted flow from 63 square miles results in a directly tributary drainage area for Quinsigamond Pond of 51.7 square miles.

Applying one-half the PMF rate to the 51.7 square miles and using an appropriate reduction factor for areas exceeding 10 square miles results in a calculated inflow test flood of 20,475 cfs. The Worcester Diversion just upstream of Leesville Pond can divert 6,000 cfs directly to the Blackstone River downstream of Quinsigamond Dam. Therefore, the final adjusted inflow test flood is anticipated to be 14,475 cfs.

An alternative method for verification of the calculated inflow test flood was to use the peak outflows of both Coes and Leesville Reservoirs (calculated in previous Phase I Inspection Reports MA 00120 and 00141) plus the total flow from the remaining 8.7 square miles of drainage to Quinsigamond. This method gives an inflow test flood of 19,800 cfs.

The average of the two flow rates was calculated to be 17,140 cfs (332 cfs per square mile) and was used as the inflow test flood for this analysis. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 17,075 cfs, with the water surface at El 448.8. Flow over the crest of the embankment is predicted to be 1,020 cfs while flow over the main spillway would be 16,055 cfs. The maximum head on the dam would be 3.1 feet, with a discharge of 14 cfs per foot of width. The depth of water over the dam at critical flow would be 0.76 feet with a velocity of 5.0 feet per second.

Hydraulic analyses indicate that the spillway can discharge flows of 6,600 cfs with a water surface at El 445.7 which is a low point of the dam.

b. Experience Data. Hydraulic records are not available. A review of past records and discussions with County personnel indicated that the dam was not overtopped during the 1938 or the 1955 floods; however, the 1936 flood reached El 447 as indicated on the list of partial inspections (see page B-4). This is 1.5 feet above the low point on the crest of the dam but below the top of the railroad rails just downstream of the dam.

c. Visual Observations. Discharge from Quinsigamond Pond is over an arched, masonry spillway about 155 feet long with an 8 foot vertical downstream face. Water flows beneath a railroad trestle bridge about 20 feet downstream and then through a more constricted opening under Greenwood Street. Two unknown outlet structures are located at the southerly end of the dam. There is also evidence of two other abandoned outlets within the pond.

Eighteen-inch-high flashboards are present along the spillway although in one section the flashboard has partially fallen off. Immediately upstream of the spillway, at the north abutment, the approach is filled with silt and cluttered with debris.

d. Overtopping Potential. Overtopping of the dam is expected under the inflow test flood of 17,140 cfs. Failure of the dam during peak test flood outflow would cause only a small increase in discharge. This is due to the fact that the spillway would already be discharging at a high rate under the test flood and would be submerged by the discharge tailwater.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Quinsigamond Pond Dam is based on the visual inspection of August 3, 1978. Based on the visual observations as detailed in Section 3, Visual Inspection, Quinsigamond Pond Dam does not appear to be unstable. However, in the event the soil is removed upstream of the spillway, an unstable condition could result. An analysis to determine the limits of dredging should be performed so that the stability and impermeability of the dam is unimpaired.

b. Design and Construction Data. The 1891 drawing showing the details of the spillway section is the only available information relative to the design and construction of the dam. Information on the type, shear strength, and permeability of the soil and/or rock materials of the dam embankment does not appear to exist.

The cutoff for the spillway is shown in Figure B-3 as 4-inch sheeting in concrete. Protection of the downstream toe of the spillway is provided by a concrete slab and wood planking.

c. Operating Records. There is no evidence that instrumentation of any type was ever installed in Quinsigamond Pond Dam. The performance of this dam under prior loading can only be inferred by previous records and physical evidence at the site.

d. Post-Construction Changes. There are no as-built drawings for the dam. As discussed in Section 1.2.h, previous inspection reports indicate that in 1936 a cutoff of wood sheeting and 36 feet of earth embankment were constructed. In 1945, a "new concrete headwork" had been constructed for the outlet gate near Greenwood Street.

e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analyses.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Quinsigamond Pond Dam was neither designed nor constructed according to the current approved state-of-the-art procedures. Based upon the visual inspection at the site, the lack of engineering data, and limited evidence of operational or maintenance procedures; there are areas of concern which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in fair condition. One of the most serious signs of distress observed at the site was extensive deposition of silt upstream of the spillway. On the northern half of the weir, where the flashboards are in place, soil, weeds, and brush have accumulated above the crest of the spillway. This condition restricts flow over about 90 feet of the spillway. In addition, silt which has been deposited farther upstream has significantly reduced the storage capacity of the pond. The flashboards on the southern portion of the weir have been washed away, and normal flow is over that section of the spillway. That area is also silted up on the upstream face almost to the crest.

Other signs of distress are: the growth of grass between stone blocks on the face of the spillway, the missing gate stem on the outlet at the south end of the spillway, trees growing on the earth embankment near the outlet structures, and stonework missing from the north abutment of the spillway.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 6,600 cfs at El 445.7 which is the low point on the crest of the dam. An inflow test flood of 17,140 cfs will overtop the dam by a maximum of 3.1 feet.

Previous records indicate the dam may have been overtopped by 1.5 feet during the 1936 storm. However, due to the present regulating effects of the upstream flood control structure which was installed in 1959, it is unlikely that this is a serious hazard.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

d. Need for Additional Information. Additional investigations to further assess the adequacy of this dam are not required at the present time except in regard to the limits of dredging to remove accumulated soil. Remedial measures for repairing and maintaining the dam are stated below in Section 7.3 Remedial Measures.

7.2 Recommendations. As a result of the visual inspection and a review of available data, further investigations to assess the adequacy of the dam are not considered necessary at this time except in regard to proposed dredging. Prior to any dredging it is recommended that the Owner employ a qualified consultant to determine the limits of dredging so that the stability and impermeability of the dam is unimpaired. Also, future changes within the watershed or to the dam and/or spillway may necessitate further investigations.

The recommendations on repair and maintenance procedures are stated below in Section 7.3.

7.3 Remedial Measures

a. Alternatives. An alternative to recommendations above and the maintenance procedures

itemized below would be to drain the pond and breach or remove the dam. However, prior to breaching the dam all accumulated soil within the pond should be removed and disposed of off-site.

b. Operating and Maintenance Procedures. The dam and appurtenant structures are not adequately maintained. It is recommended that the Owner accomplish the following:

(1) remove the flashboards from the northern 90 feet of the weir of the spillway

(2) dredge soil and vegetation from the area upstream of the spillway. The limits of dredging should be based on an analysis as recommended above

(3) repair the gate stem on the outlet works next to the south abutment of the spillway and determine that the gate operates properly

(4) clear trees and brush from the earth embankment at the south end of the dam near the outlet structures

(5) repair stone blocks missing from the top of the wall just upstream of the north abutment of the dam

(6) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff; this should be coordinated with the operators of upstream reservoirs

(7) implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a monthly inspection of the dam and appurtenances supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.

(8) periodic technical inspections of this dam should be continued on a bi-annual frequency.

APPENDIX A

PERIODIC INSPECTION CHECK LIST

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Quinsigamond Pond

DATE August 3, 1978

TIME 8:00 AM - 1:00 PM

WEATHER Sunny - 75°F

W.S. ELEV. 441.1* U.S. ~~434.5~~ D.N.S.

*assumed benchmark El 441 at spillway crest from USGS topo quad

PARTY:

1. Lyle Branagan
2. David Cole
3. Lou Taverna
4. Ed Greco
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	dam and spillway	Lyle Branagan and Ed Greco	
2.	outlets	Lyle Branagan	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Quinsigamond Pond Dam DATE August 3, 1978

PROJECT FEATURE dam embankment NAME Lyle Branagan

DISCIPLINE geotechnical NAME Ed Greco

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	varies from 445.5 to 446.2
Current Pool Elevation	441.1
Maximum Impoundment to Date	unknown
Surface Cracks	none visible
Pavement Condition	not applicable
Movement or Settlement of Crest	minor irregularities
Lateral Movement	none visible
Vertical Alignment	relatively flat
Horizontal Alignment	relatively straight
Condition at Abutment and at Concrete Structures	fair to good
Indications of Movement of Structural Items on Slopes	none visible
Trespassing on Slopes	upstream face heavily silted
Sloughing or Erosion of Slopes or Abutments	none visible
Rock Slope Protection - Riprap Failures	none visible
Unusual Movement or Cracking at or near Toes	none visible
Unusual Embankment or Downstream Seepage	minor seepage
Piping or Boils	none visible
Foundation Drainage Features	none visible
Toe Drains	none visible
Instrumentation System	none visible

PERIODIC INSPECTION CHECK LIST

PROJECT Quinsigamond Pond Dam DATE August 3, 1978

PROJECT FEATURE Spillway NAME Lyle Branagan

DISCIPLINE geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	same as river channel
General Condition	severe siltation
Loose Rock Overhanging Channel	none
Trees Overhanging Channel	small trees + brush
Floor of Approach Channel	natural stream bed
b. Weir and Training Walls	fair to good - stone masonry
General Condition of Concrete	not applicable
Rust or Staining	not applicable
Spalling	not applicable
Any Visible Reinforcing	not applicable
Any Seepage or Efflorescence	minor seepage
Drain Holes	not applicable
c. Discharge Channel	under RR bridge + Greenwood Street
General Condition	fair to good with some debris
Loose Rock Overhanging Channel	no
Trees Overhanging Channel	small trees
Floor of Channel	natural with concrete + wood scour protection
Other Obstructions	two adjacent bridges

PERIODIC INSPECTION CHECK LIST

PROJECT Quinsigamond Pond Dam DATE August 3, 1978

PROJECT FEATURE outlet structures NAME Lyle Branagan

DISCIPLINE geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	same as river channel
Slope Conditions	vertical masonry wall
Bottom Conditions	natural channel
Rock Slides or Falls	none
Log Boom	not applicable
Debris	minor
Condition of Concrete Lining	not applicable
Drains or Weep Holes	not applicable
b. Intake Structure	two inlets
Condition of Concrete	fair to good
Stop Logs and Slots	no logs- slots in concrete

PERIODIC INSPECTION CHECK LIST

PROJECT Quinsigamond Pond Dam DATE August 3, 1978

PROJECT FEATURE outlet structures NAME Lyle Branagan

DISCIPLINE geotechnical NAME Ed Greco

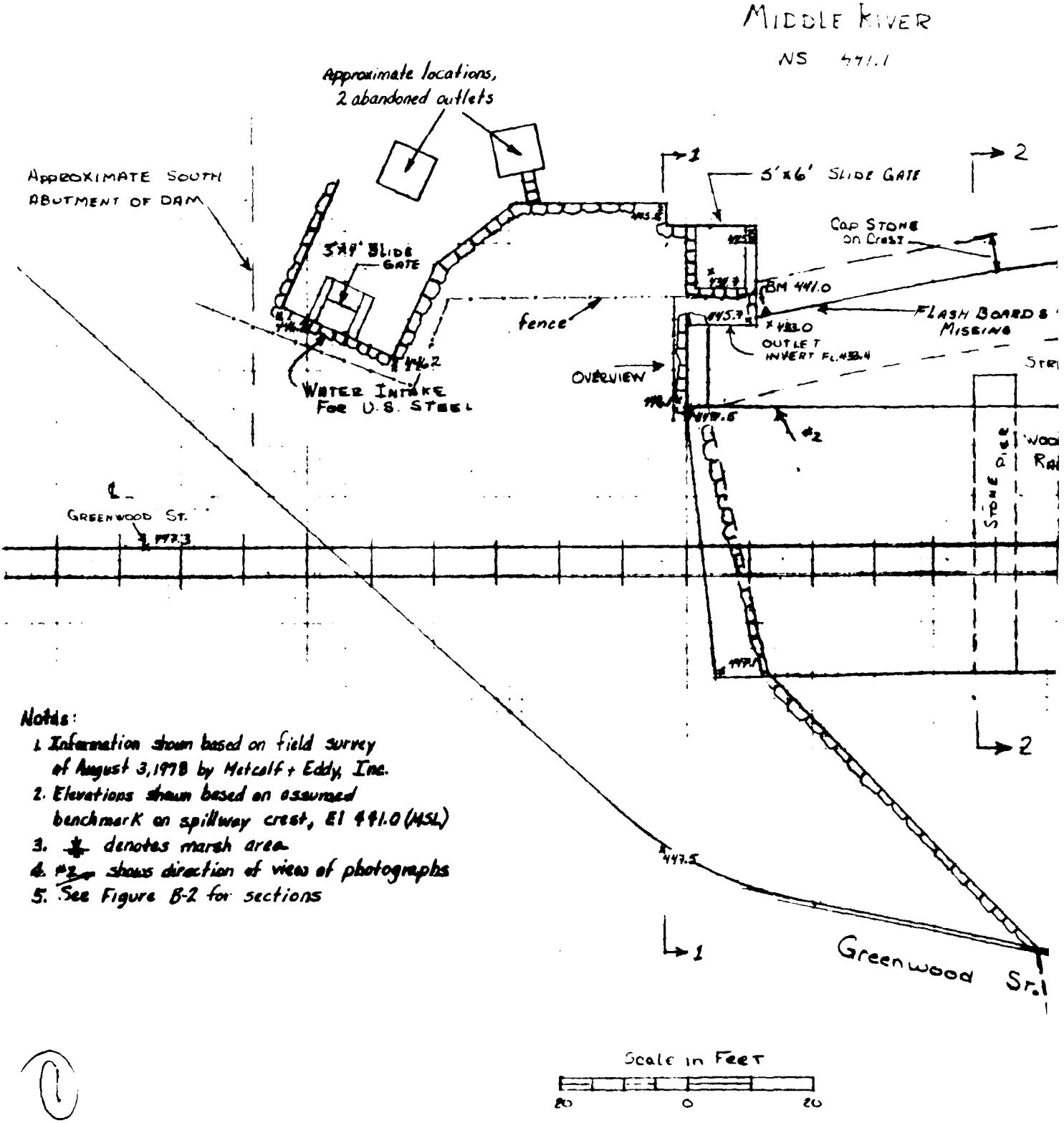
AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	fair to good
Rust or Staining on Concrete	none
Spalling	minor
Erosion or Cavitation	minor
Cracking	none visible
Alignment of Monoliths	not applicable
Alignment of Joints	fair to good
Numbering of Monoliths	not applicable

discharge channels:

outlet next to spillway - same channel as spillway

outlet next to Greenwood St - discharge off site

APPENDIX B


MIDDLE RIVER
NS 441.1
Approximate locations, 2 abandoned outlets
APPROXIMATE SOUTH ABUTMENT OF DAM
5'x6' SLIDE GATE
5'x9' SLIDE GATE
CAP STONE on Crest
BM 441.0
FLASH BOARDS MISSING
fence
OUTLET INVERT EL. 432.4
WATER INTAKE FOR U.S. STEEL
OVERVIEW
GREENWOOD ST.
STONE PIER
Greenwood St.
Notes:
1. Information shown based on field survey of August 3, 1978 by Metcalf + Eddy, Inc.
2. Elevations shown based on assumed benchmark on spillway crest, El 441.0 (MSL)
3. denotes marsh area
4. shows direction of views of photographs
5. See Figure B-2 for sections
Scale in Feet
80
0
20

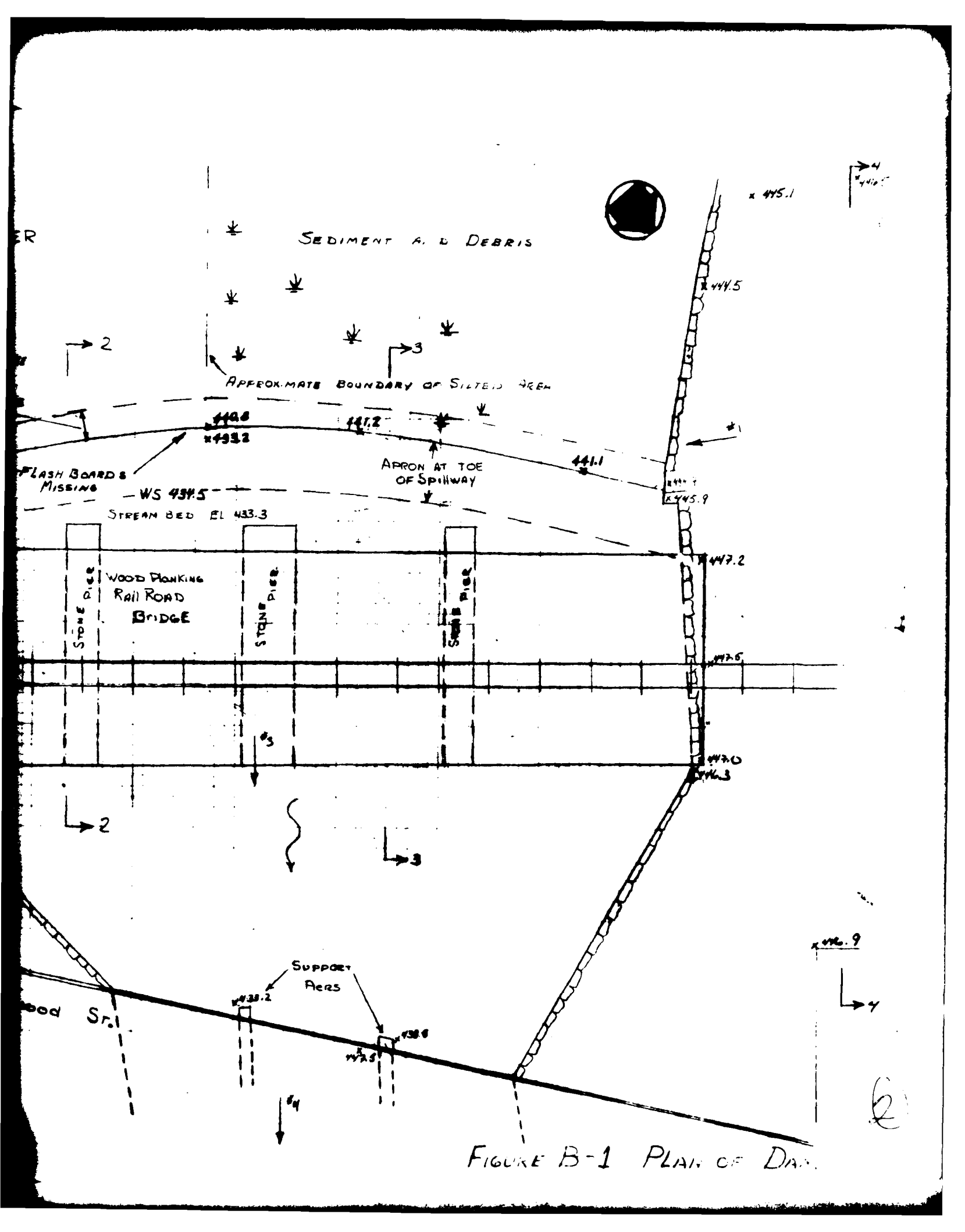
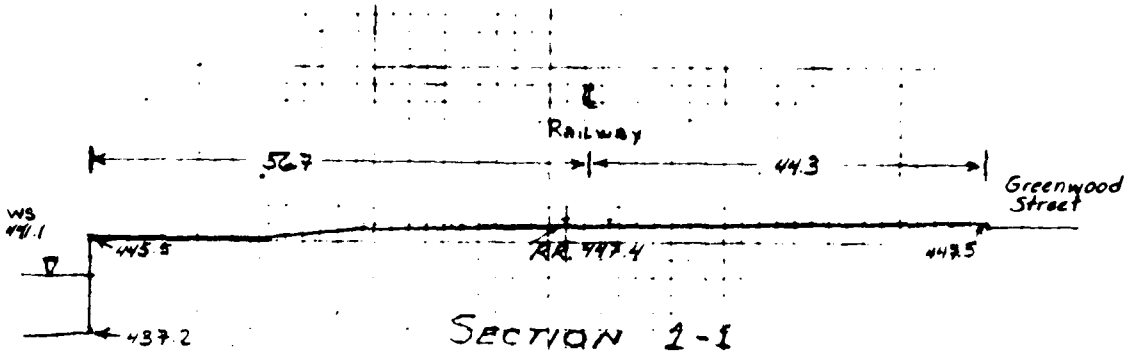
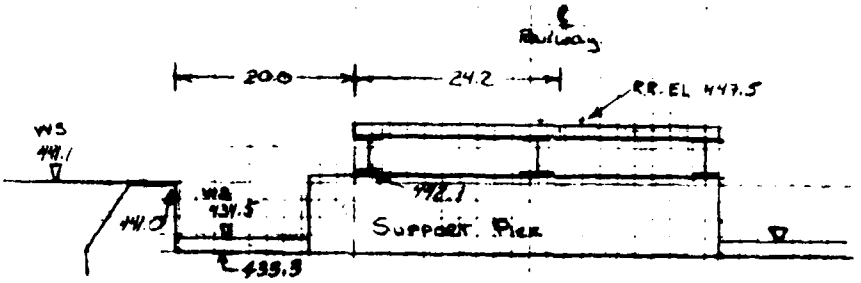


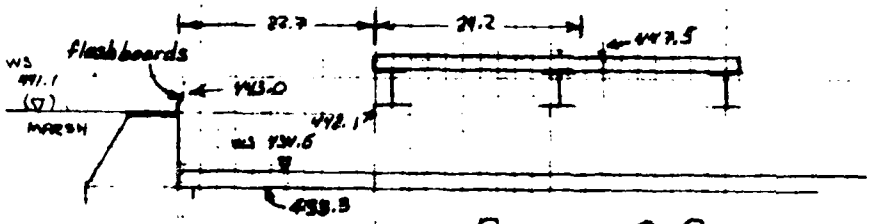
FIGURE B-1 PLAN OF DAM



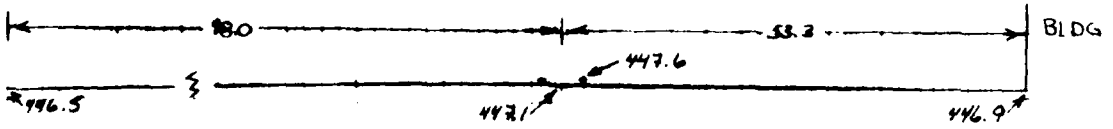
SECTION 1-1



SECTION 2-2



SECTION 3-3



SECTION 4-4

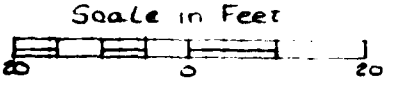
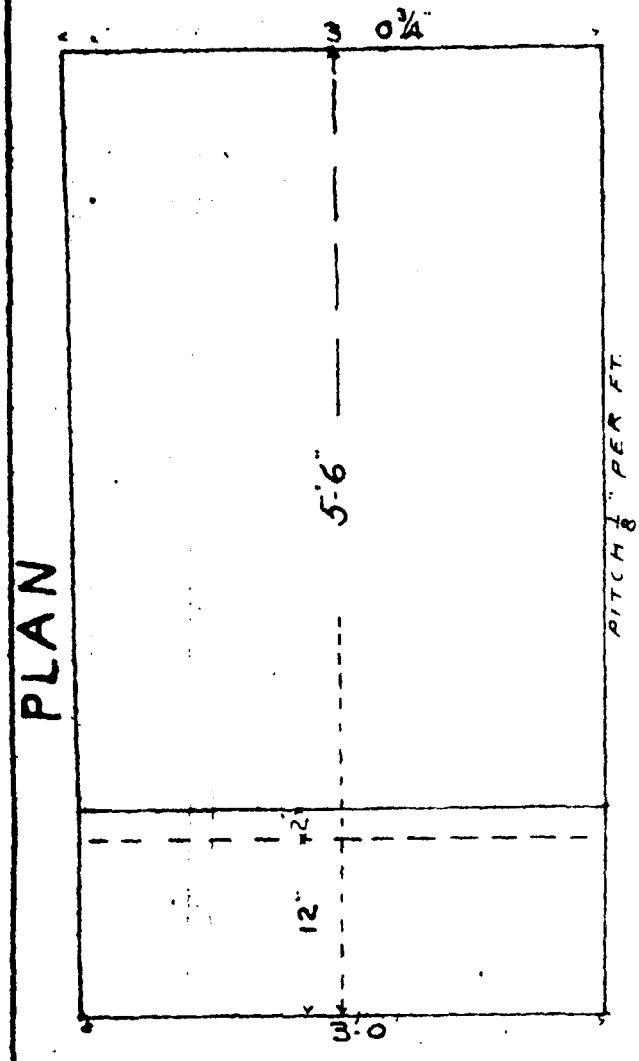
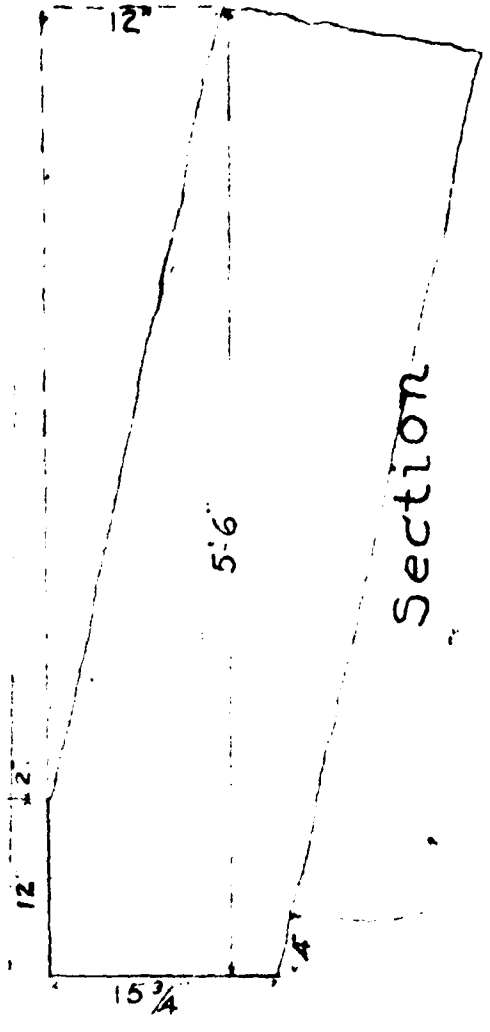


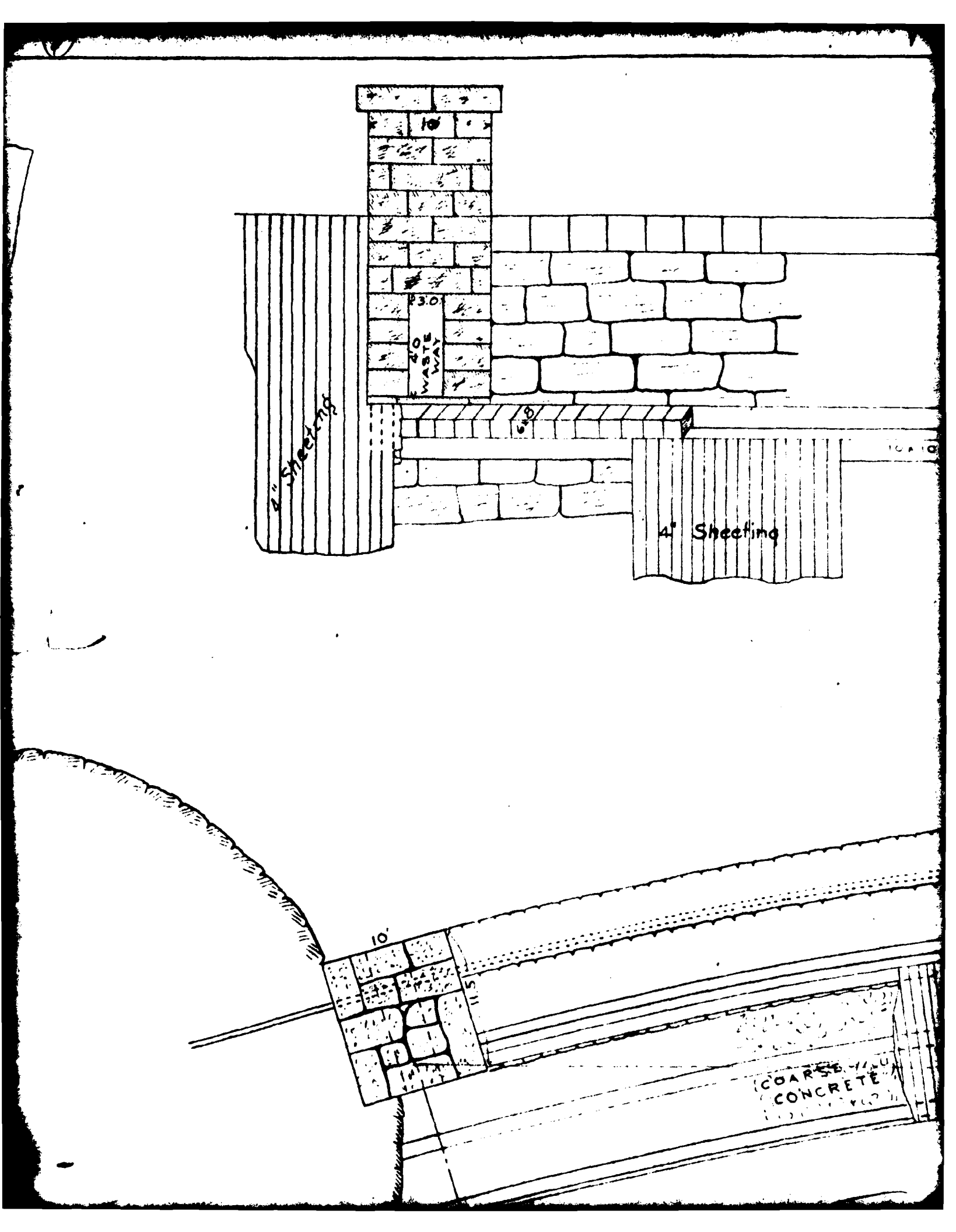
FIGURE B-2 SECTIONS

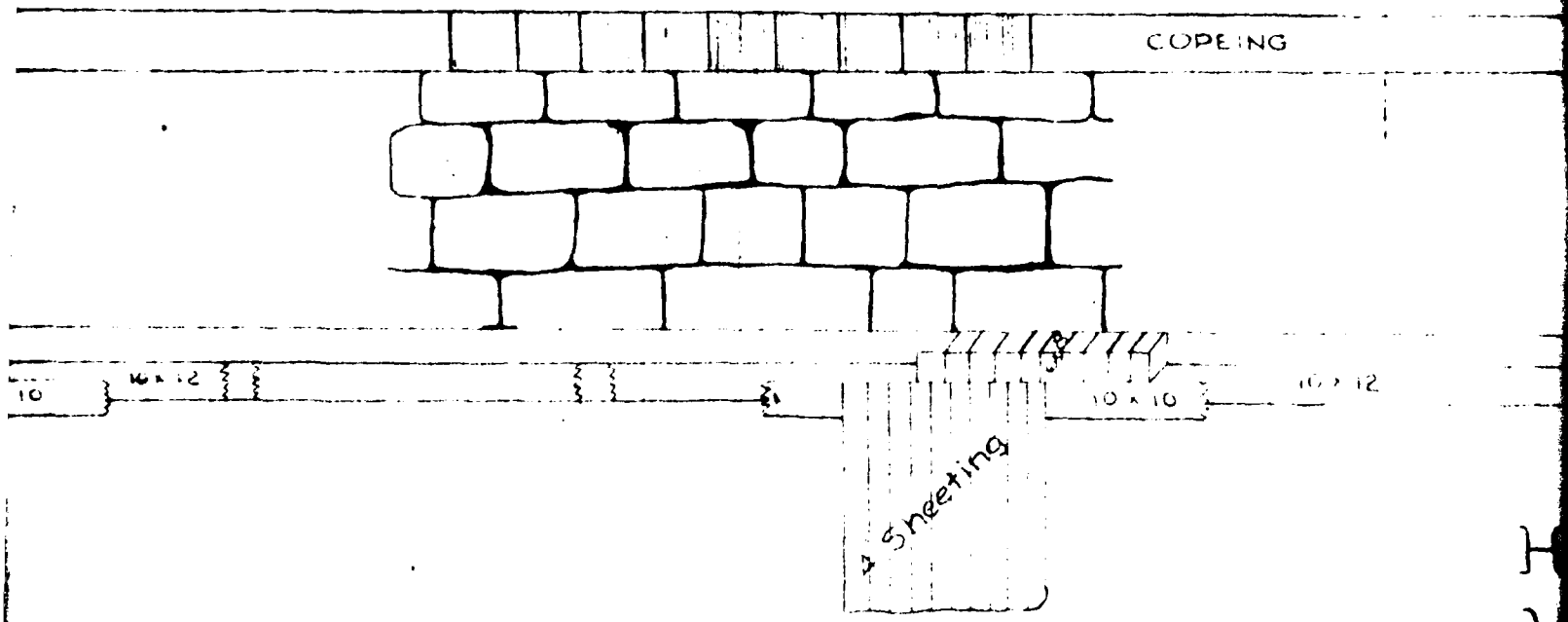


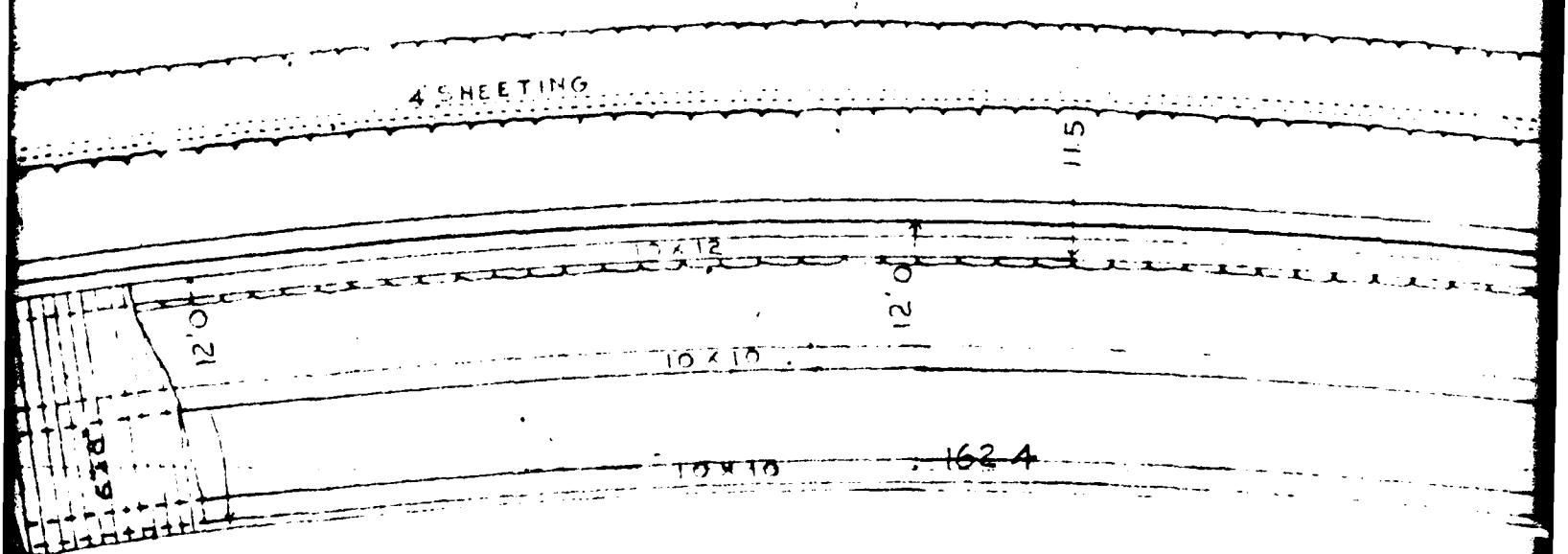


Detail of Copeing

SCALE 1" = 1'

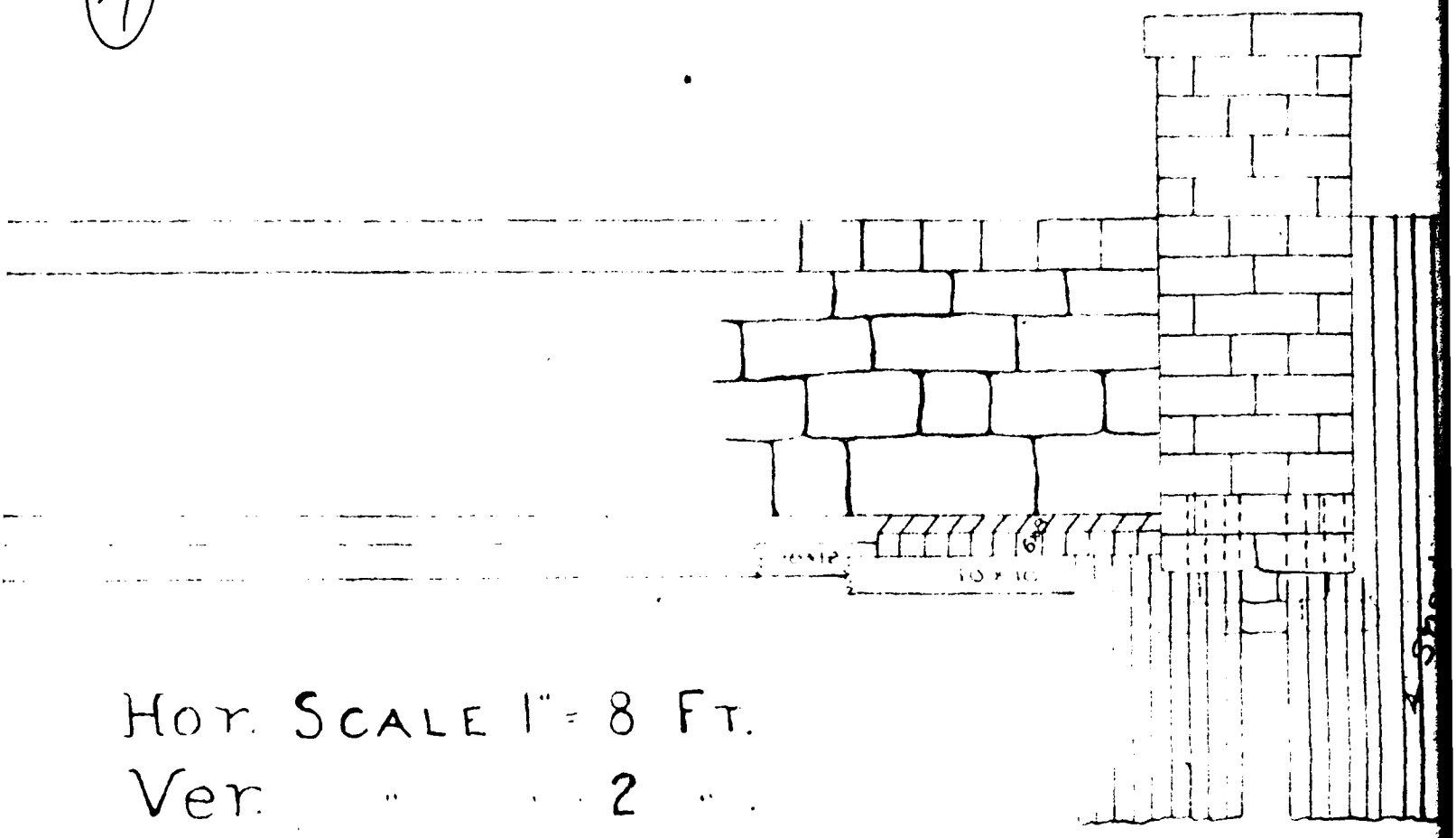

10'
3.0'
4" Sheeting
4" Sheeting
10'
COARSE
CONCRETE


COPEING
10
10 x 12
10 x 10
10 x 12
4 Sheeting

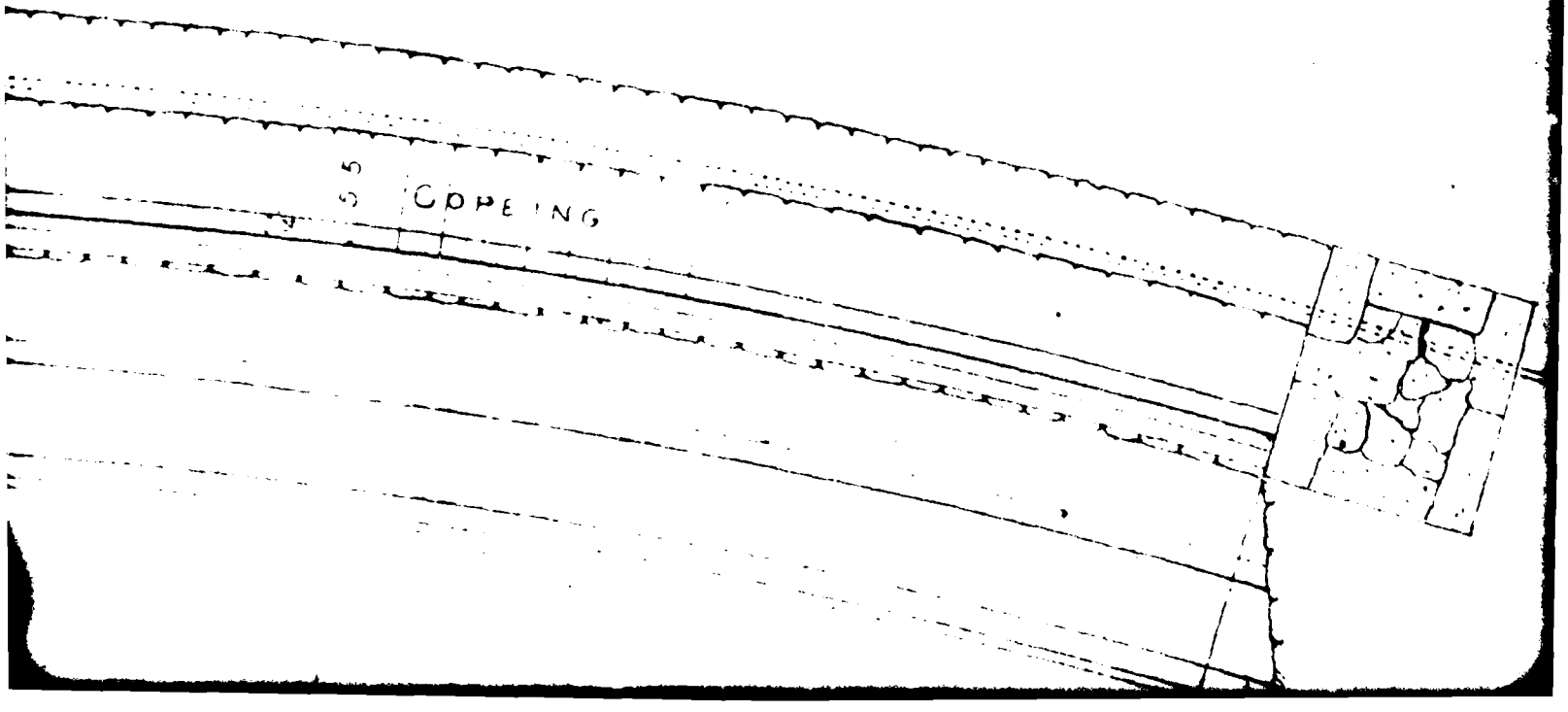

4 SHEETING
11.5
10 x 12
12.0
12.0
10 x 10
10 x 10
162.4

PLAN

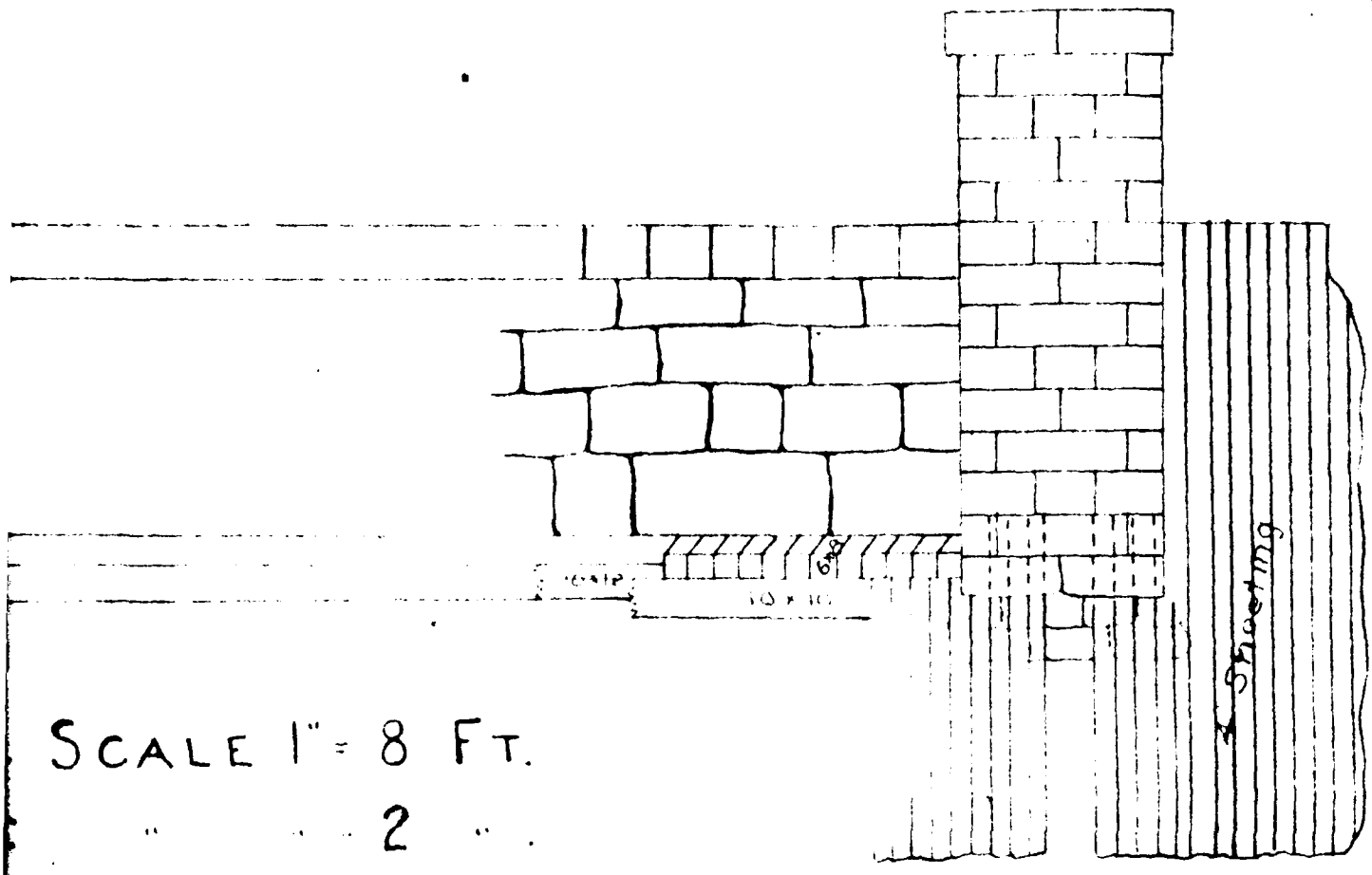
(4)



Hor. Scale 1" = 8 Ft.
Ver. " " 2 " .



(5)



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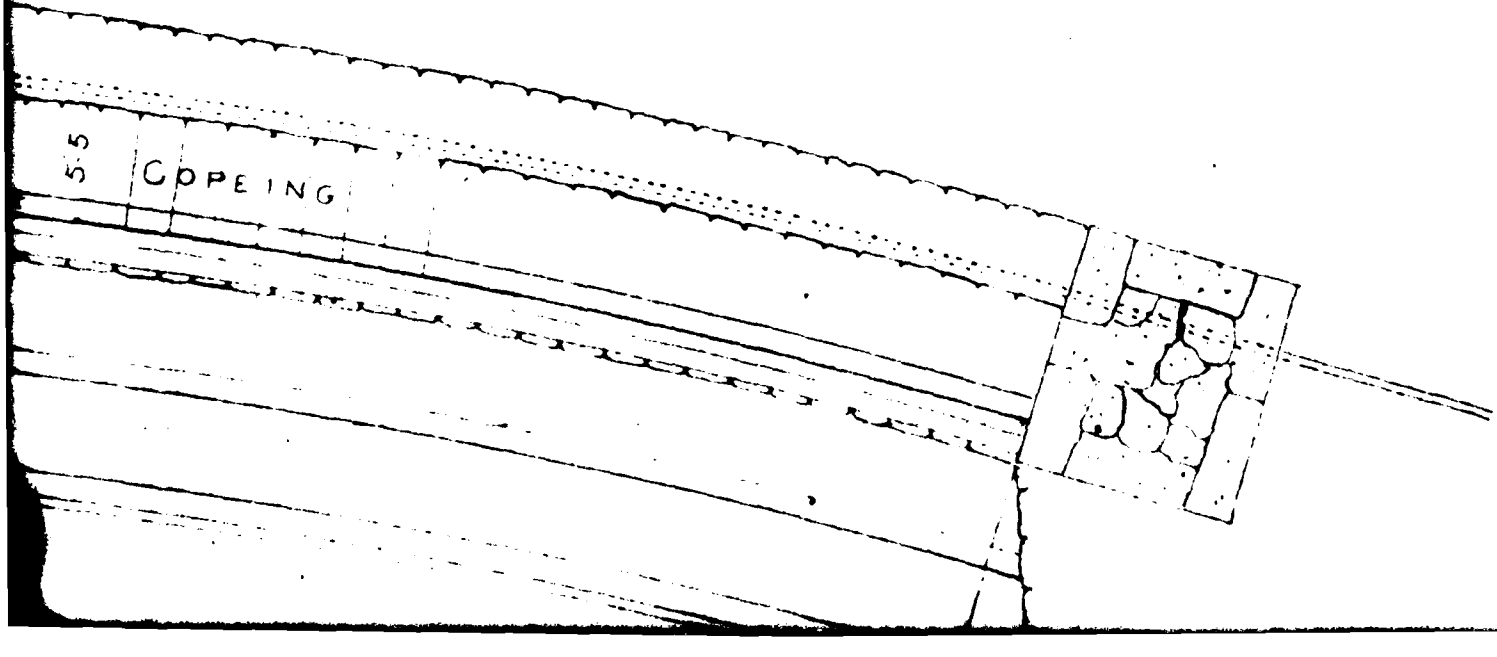
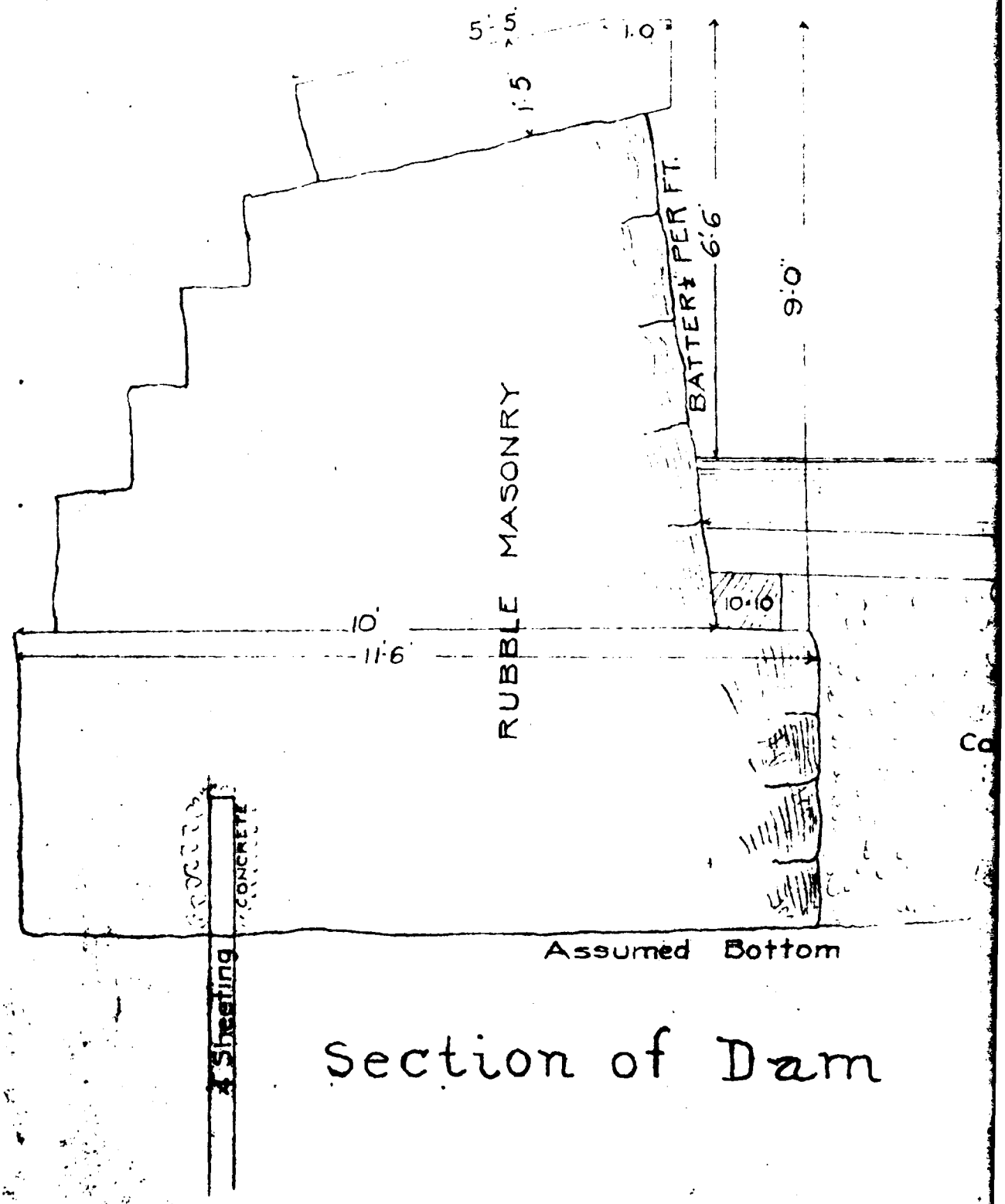
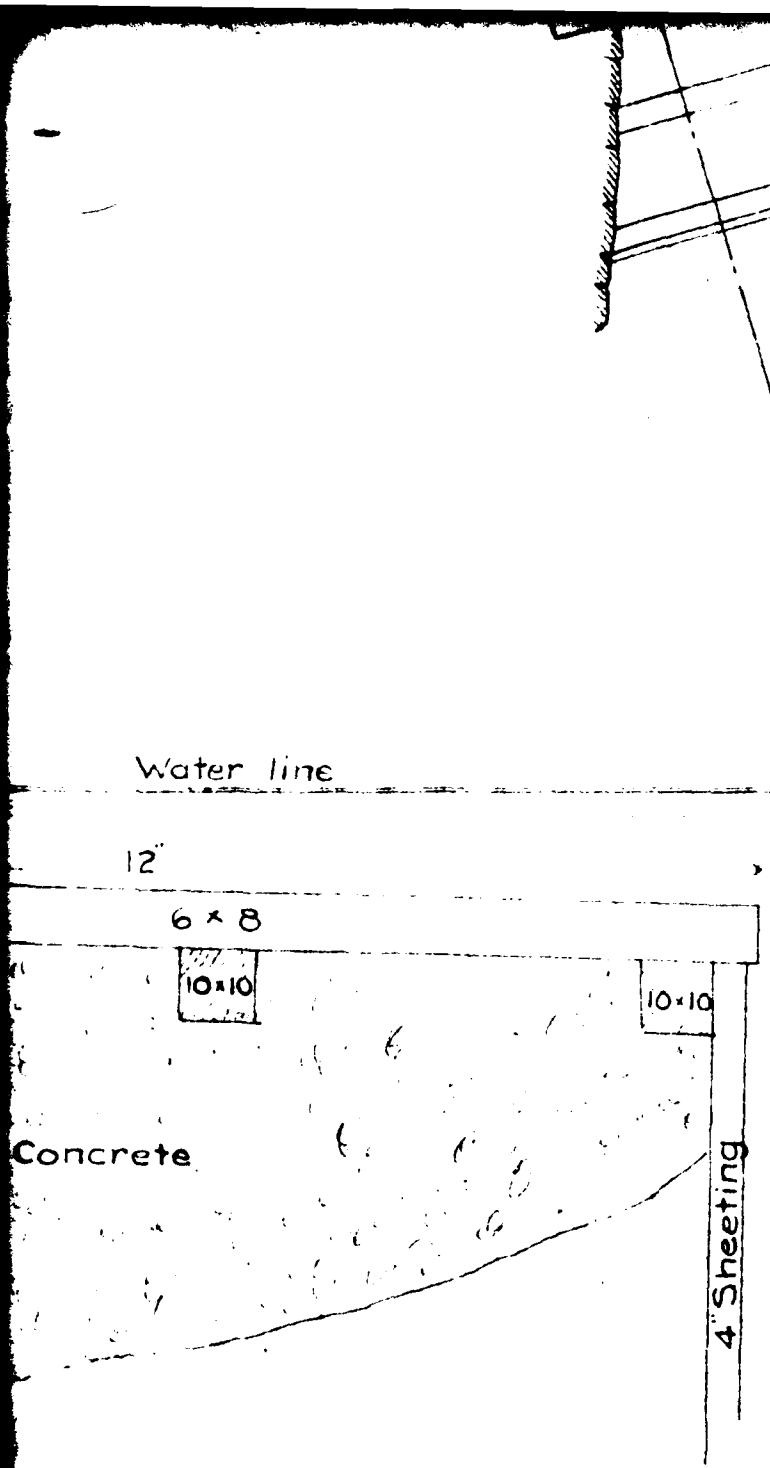




Section of Dam



Scale: ½"=1'

PLAN

SCALE

CALE 1" = 8 FT.

RAD 68.72'

J.W. Ellis C

WOONSOC

WORCESTER COUNTY COMMIS

WORCESTER COUNTY ENGINEERING

PLAN OF

DAM

ACROSS THE BLACKSTONE R

WORCESTER, MAS

FOR THE WASHBURN & MOEN

AS FILED AND APPROVED

COUNTY COMMISSI

JULY 28, 1891

JUNE MEETING DOCI

SCALES AS NOTED

TRACED BY: [illegible] 3-4-36

TRACING CHECKED BY: L.O. Marden 3-6-36

DA

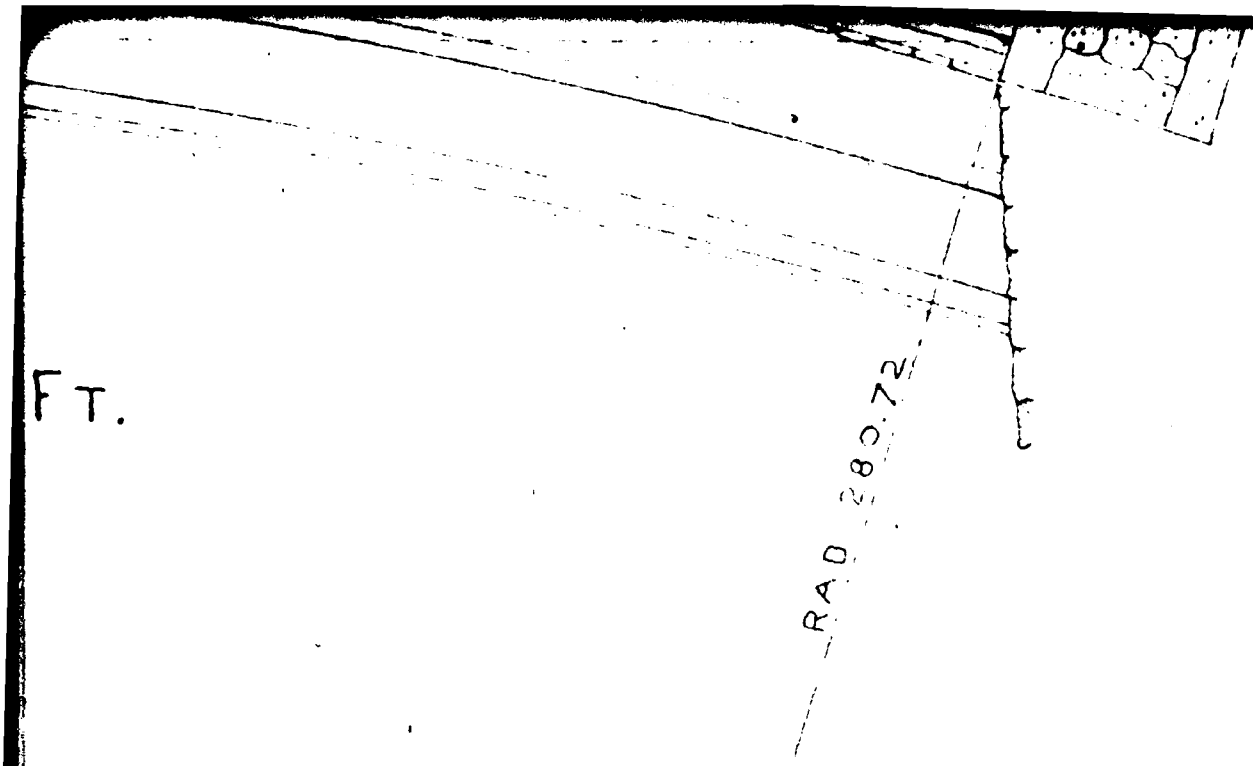
L.O. Marden

COUN

Attest Williams C

(9)

FIGURE B-3



J.W. Ellis C.E.
WOONSOCKET R.I.

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT

PLAN OF
DAM
ACROSS THE BLACKSTONE RIVER
WORCESTER, MASS.
FOR THE WASHBURN & MOEN MF'G. CO.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
JULY 28, 1891
JUNE MEETING DOCKET 122
SCALES AS NOTED

TRACED BY: [illegible] 3-4-36
TRACING CHECKED BY: L O Mardens 6-36

DAM NO. 61-01

L O Mardens COUNTY ENGINEER

Attest William C. Bowen
Clerk

FIGURE B-2

TOWN OR CITY Worcester DECREE NO. 122 PLAN NO. DAM NO. ~~61~~-01 348

LOCATION South Works - Millbury St., Quinsigamond Pond.

DESCRIPTION OF DAM

Type	Earth. Stone faced spillways.
Length	
Height	9.0'
Thickness top	5'-5"
" bottom	10'-0"
Downstream Slope	1½:1
Upstream "	
Length of Spillway	El. Top of Weir 437.8 125' ~~152'~~
Size of Gates	3'x3'
Location of Gates	So. End Spillway
Flashboards used	None.
Width Flashboards or Gates	"
Dam designed by	J.W. Ellis.
" constructed by	
Year constructed	1906

GENERAL REMARKS

U.S. Steel Co.?

Owned by Am. Steel & Wire Co.
Vol. 28 - P. 30. - July 28, 1891, June Mtg.
Inspected Oct. 5, 1925. L.A.M. O.K.
Plan - "Dams" C.C. Office
Inspected: Oct. 29, 1928 / L.O.M. OK.
" : Sept. 29, 1932 / "
" : Mar. 1, 1933 / "
" : Nov. 18, 1938 / L. H. Spofford
" : Dec. 19 1940. " "

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream	Blackstone River.
" " any other Streams	
Length of Watershed	
Width " "	
Is Watershed Cultivated	
Percent in Forests	
Steepness of Slope	
Kind of Soil	
No. of Acres in Watershed	58.95 & 11
" " " " Reservoir	
Length of Reservoir	
Width " "	
Max Flow Cu. Ft. per Sec.	
Head or Flashboards-Low Water	
" " " -High "	

GENERAL REMARKS

New Plans & Specs approved 9-15-36 by C.C.
See plan in Commissioners Office

Docket #122. Meeting June, 1891. Filed July 28, 1891
Traced by: L.C. Farrar, March 4, 1936.
Checked by: L.O. Marden " 6, "
Attested by: William C. Bowen C. of C.
J.W. Ellis, C.E. - Woonsocket, R.I.
1936 Flood 447.0

2-Library Bureau 10-97208

B-4

PREVIOUS INSPECTIONS (PARTIAL LISTING)

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.

Inspected: Dec. 11, 1945 - W.O. Lindquist

61-01

June 16, 1998 LOM

Repairs 1936: 36' of dike, wood sheeting, backfilling with sandy clay fill and riprap upstream side.

DESCRIPTION OF DAM

DISTRICT 3

Submitted by MULCAHY DONAHUE Dam No. 3-14-946-1

Date 2-7-73 City/Town WORCESTER

Name of Dam QUINSIGAMOND POND DAM

1. Location: Topo Sheet No. 21 B

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: _____ Year/s of subsequent repairs _____

3. Purpose of Dam: Water Supply _____ Recreational _____

Irrigation _____ Other ✓

4. Drainage Area: 58.85 sq. mi. _____ acres

5. Normal Ponding Area: 20 ± acres; Ave. depth _____

Impoundment: _____ gals.; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir 1 GAS STA 1 BUS BUILDING i.e. summer homes, etc. _____

7. Dimensions of Dam: Length 225' ± Max. Height 11'

Slopes: Upstream Face VERTICAL

Downstream Face VERTICAL

Width across top 50' ±

8. Classification of Dam by Material:

Earth ✓ Conc. Masonry _____ Stone Masonry ✓

Timber _____ Rockfill _____ Other _____

9. A. Description of present land usage downstream of dam:

_____% rural; 100 % urban.

B. Is there a storage area or flood plain downstream of dam which could accomodate the impoundment in the event of a complete dam failure? yes ✓ no _____.

DAM NO. 3-14-348-1

10. Risk to life and property in event of complete failure.

No. of people NONE.

No. of homes NONE.

No. of Businesses 1.

No. of industries 1. Type STEEL

No. of utilities NONE. Type _____

Railroads N.Y. N.H. RAILROAD.

Other dams NONE.

Other _____.

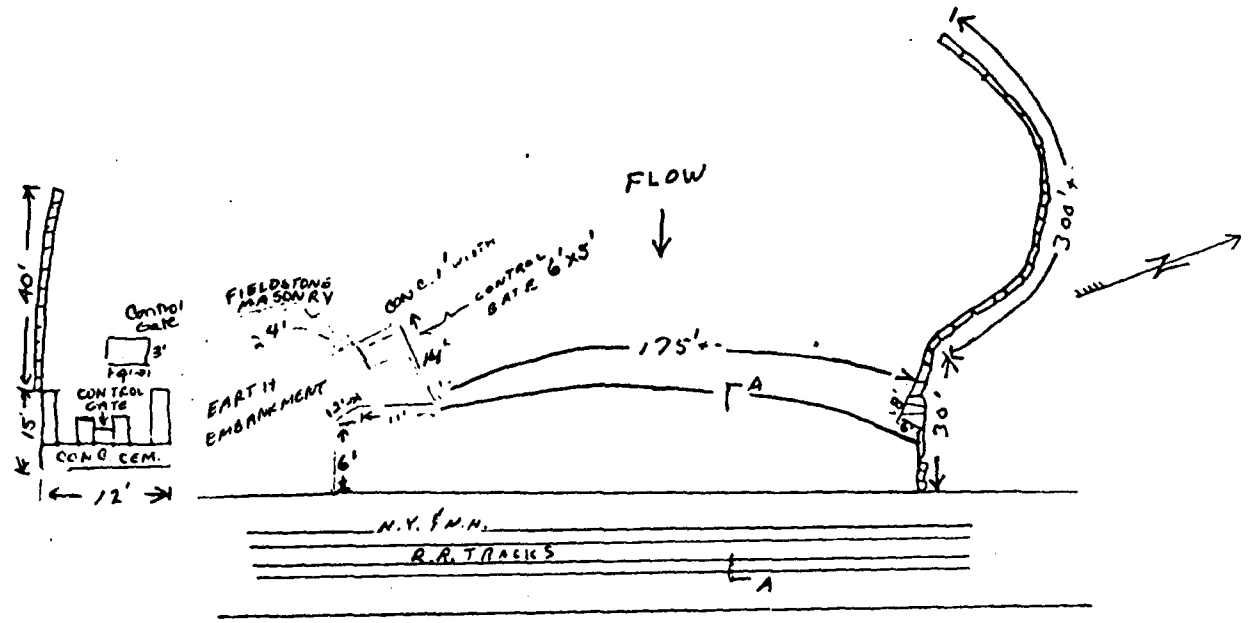
11. Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

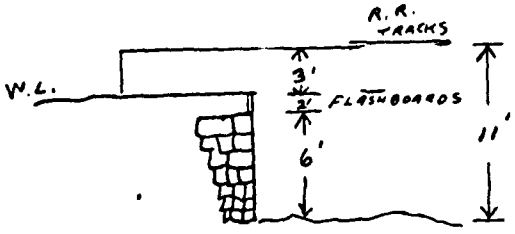
12. How to Locate: TRAVEL SOUTH ON MILLBURY ST FROM INTERSECTION OF MILLBURY & BALLARD STS, DAM ON RIGHT AT RAILROAD CROSSING.

WORCESTER

QUINSIGAMOND DAM

3-14-348-1





A-A SECTION

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town WORCESTER Dam No. 3-14-348-1

Name of Dam QUINSIGAMOND POND DAM Inspected by _____

Date of Inspection _____

2. Owner/s: per: Assessors _____ Prev. Inspection ✓

Reg. of Deeds _____ Pers. Contact _____

1. UNITED STATES STEEL CORP 767 MILLBURY ST WORCESTER
Name St. & No. City/Town State Tel. No.

2. _____
Name St. & No. City/Town State Tel, No.

3. _____
Name St. & No. City/Town State Tel. No.

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: St. & No.:

City/Town: State: Tel.No.:

4. No. of Pictures taken NONE

5. Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate ✓

3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ✓

Operative _____ yes; _____ No.

Comments:

7. Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ____ 4. Urgent Repairs ____

or Comments:

DAM NO. 3-14-348-1

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ____ 4. Urgent Repairs _____

Comments:

9. Emergency Spillway: NONE

Condition: 1. Good _____ 2. Minor Repairs _____

3. Major Repairs ____ 4. Urgent Repairs _____

Comments:

10. Water Level at time of inspection: 3 ft. above____ below ✓

top of dam ✓ principal spillway_____

other_____

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment ✓

Animal Burrows and Washouts —

Damage to slopes or top of dam FALLEN TREE ON LEFT SIDE OF DAM

Cracked or Damaged Masonry NONE VISIBLE

Evidence of Seepage NONE

Evidence of Piping NONE

Erosion NONE

Leaks NONE

Trash and/or debis impeding flow TRASH & DEBRIS IN STREAM

Clogged or blocked spillway TRASH AND DEBRIS BLOCKING SPILLWAY

Other _____

DAM NO. 3-14-348-1

12. Remarks & Recommendations: (Fully Explain)

THE STONE MASONRY SECTION OF THE DAM APPEARS TO BE IN GOOD CONDITION THE PRIMARY DEFIECIENCY IN THIS DAM IS THE AMOUNT OF TRASH AND DEBRIS LAYING ON TOP OF THE SPILLWAY FOR ALMOST HALF THE LENGTH OF THE SPILLWAY, WEEDS & HUMMOCKS GROWING IN APPROACH TO SPILLWAY COLLECT TRASH AND INHIBIT THE FLOW OF WATER, THERE IS AN UPROOTED TREE IN THE EXTREME LEFT SIDE OF THE DAM THAT IS LAYING IN THE POND ABOUT 25 FROM THE TOP OF THE SPILLWAY. REMOVAL OF THIS TREE IS NECESSARY TO PREVENT LOSS OF SECTION TO EARTH DAM AND POSSIBLE TO DAMAGE TO GRANITE MASONRY WALL, AND ALSO DAMAGE TO SPILLWAY AND DOWNSTREAM SECTION OF DAM IF THE TREE SHOULD BE SWEPT OVER THE DAM.

A 20 SECTION OF THE WOODEN FLASHBOARD AT THE EXTREME RIGHT SIDE OF SPILLWAY HAS BEEN TIPPED FORWARD AND A GREATER VOLUME OF WATER IS FLOWING THROUGH THIS SECTION OF THE DAM.

THE CONDITIONS LISTED SHOULD ALL BE CORRECTED TO INSURE PROPER FUNCTIONING OF THE DAM AND TO PREVENT POSSIBLE FUTURE DAMAGE TO THE STRUCTURE.

13. Overall Condition:

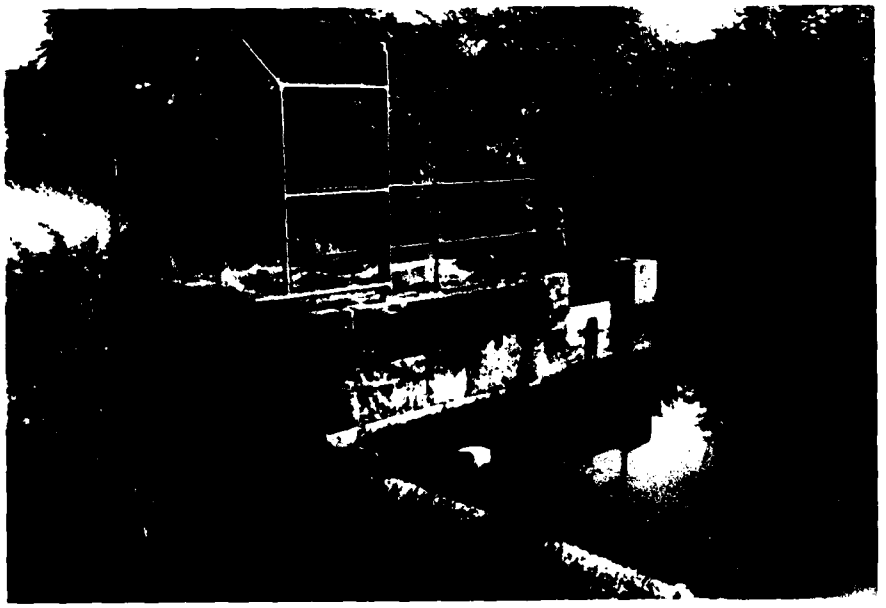
1. Safe ✓
2. Minor repairs needed ✓
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)

Recommend removal from inspection list _____

APPENDIX C

PHOTOGRAPHS

NO. 1 VIEW OF DAM CREST AND RAILROAD
BRIDGE FROM NORTH ABUTMENT



NO. 2 VIEW OF SOUTH ABUTMENT
SHOWING ABANDONED INTAKE STRUCTURE

NO. 3 VIEW OF GREENWOOD STREET BRIDGE
DOWNSTREAM FROM DAM

NO. 4 VIEW OF DOWNSTREAM CHANNEL FROM
GREENWOOD STREET BRIDGE

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

(1)

LEGEND

WATER SHED

PRIMARY ROADS

SECONDARY ROADS

THICKLY SETTLED

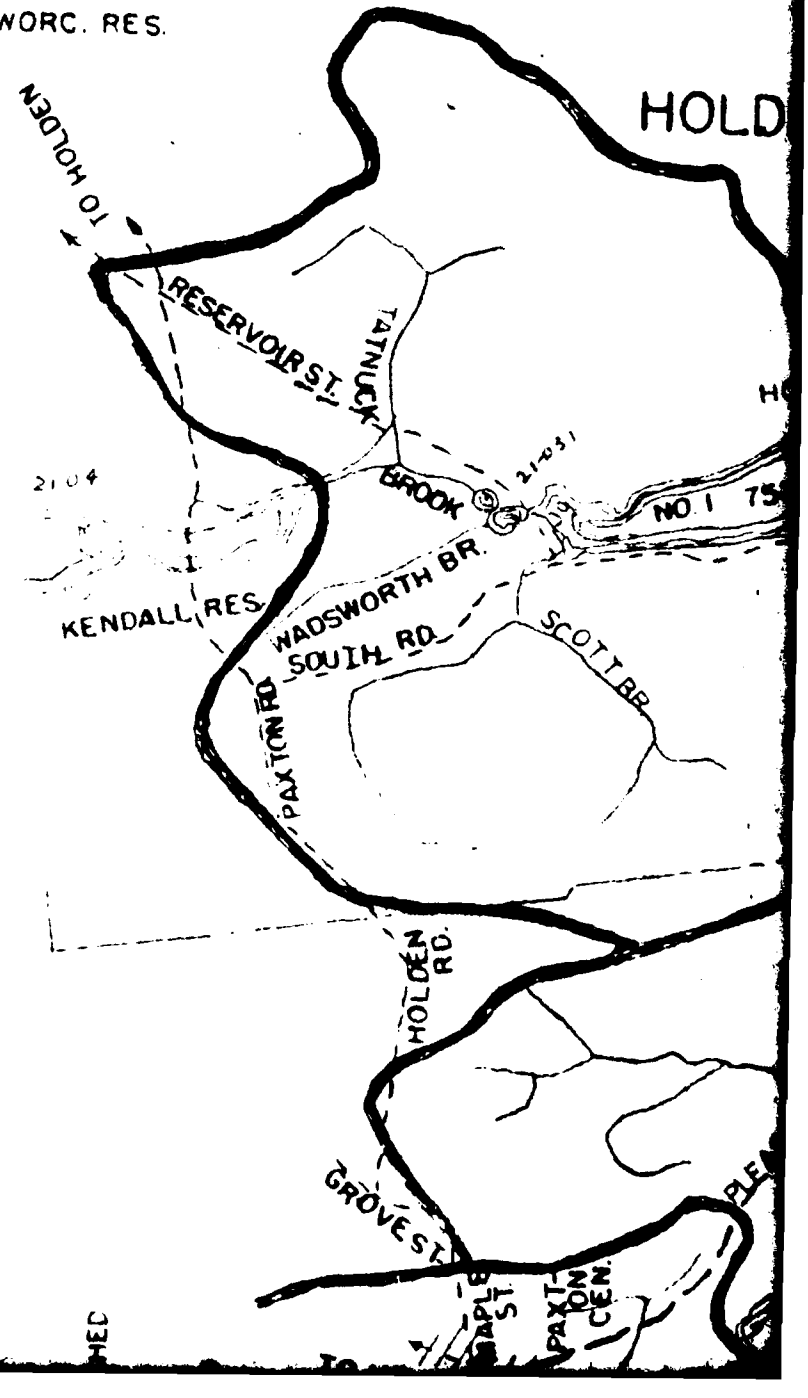
RAILROADS

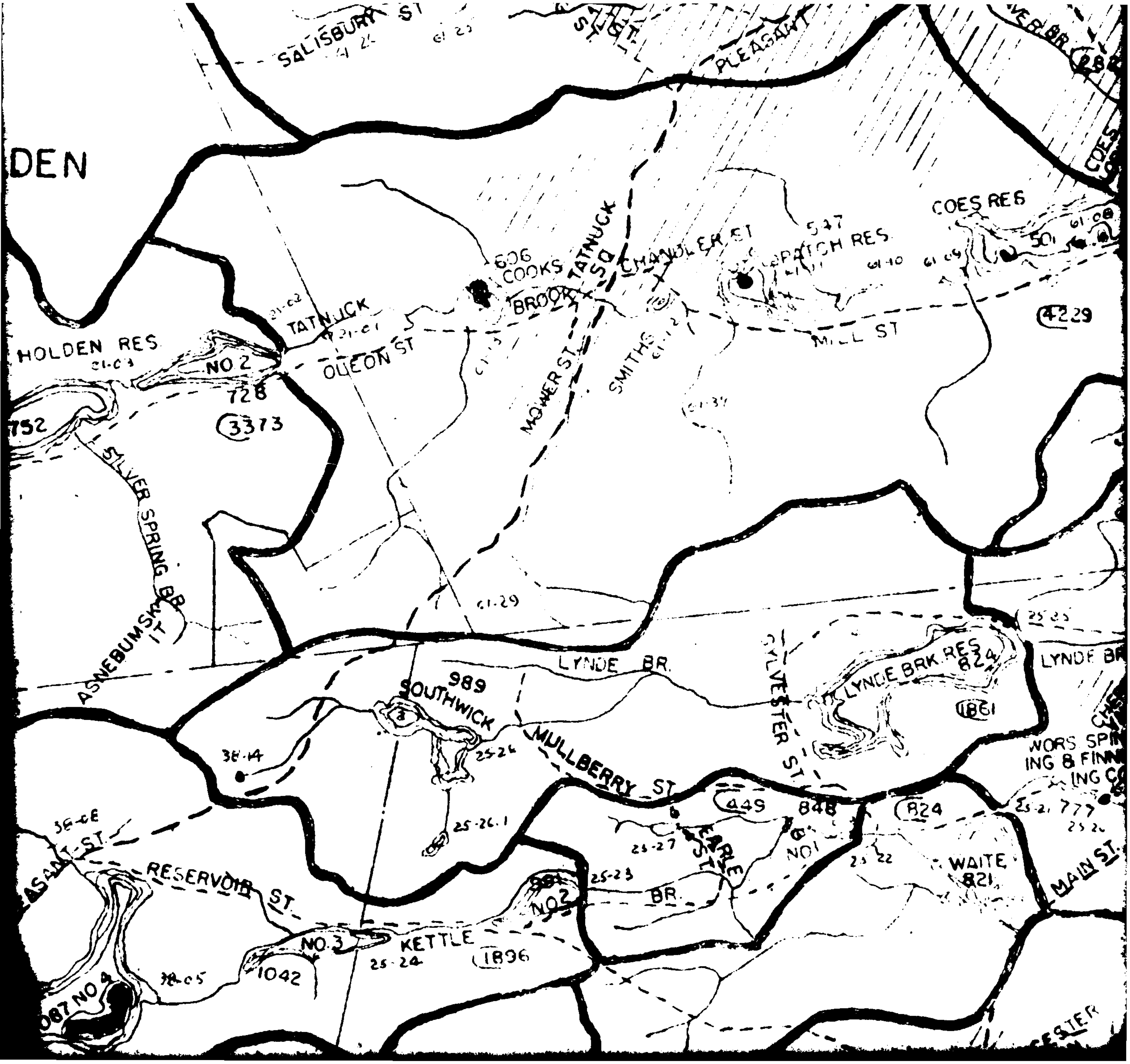
TOWN LINES

400 BODY OF WATER, DAM, ELEVATION

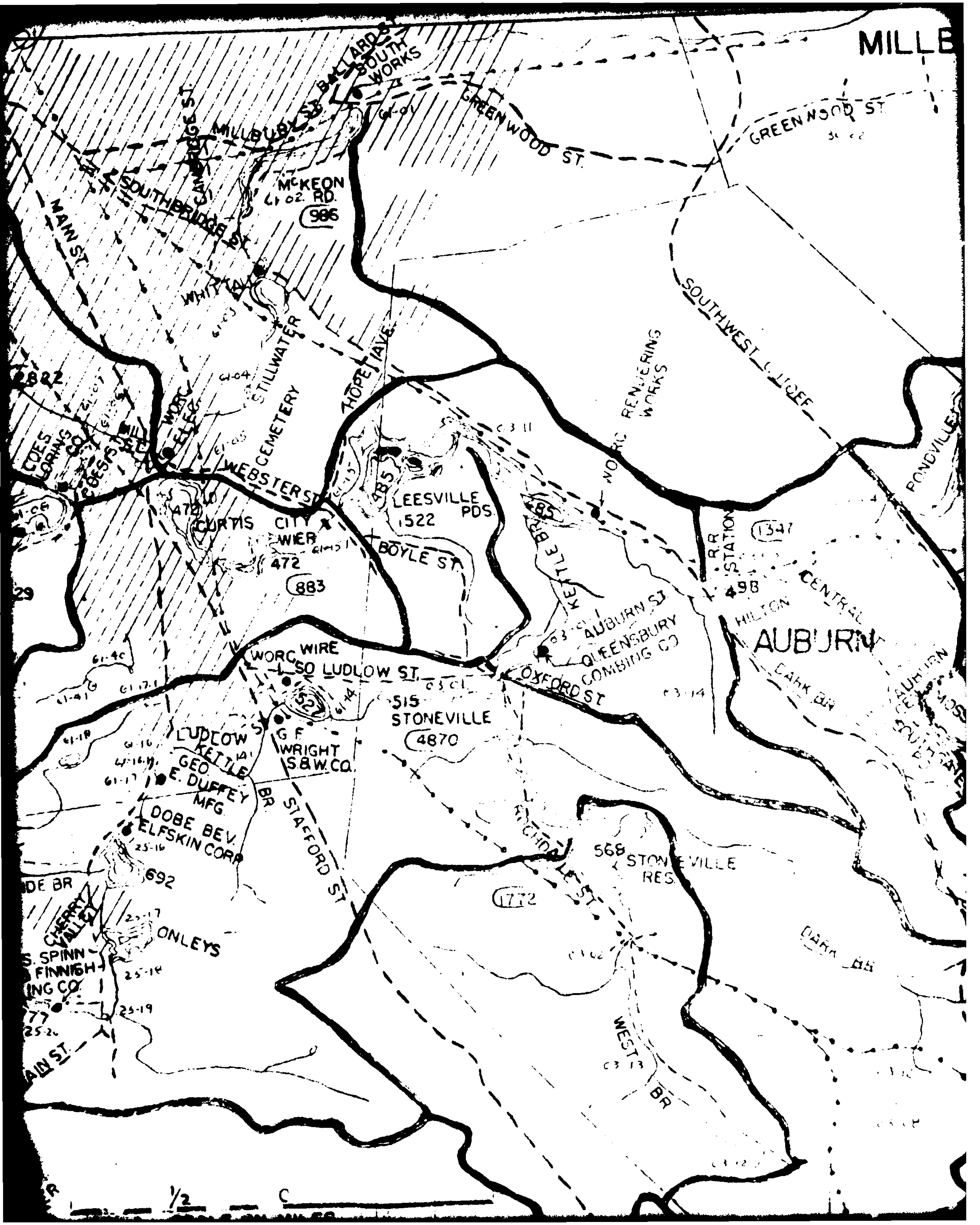
177 AREA OF WATER - SHED IN ACRES

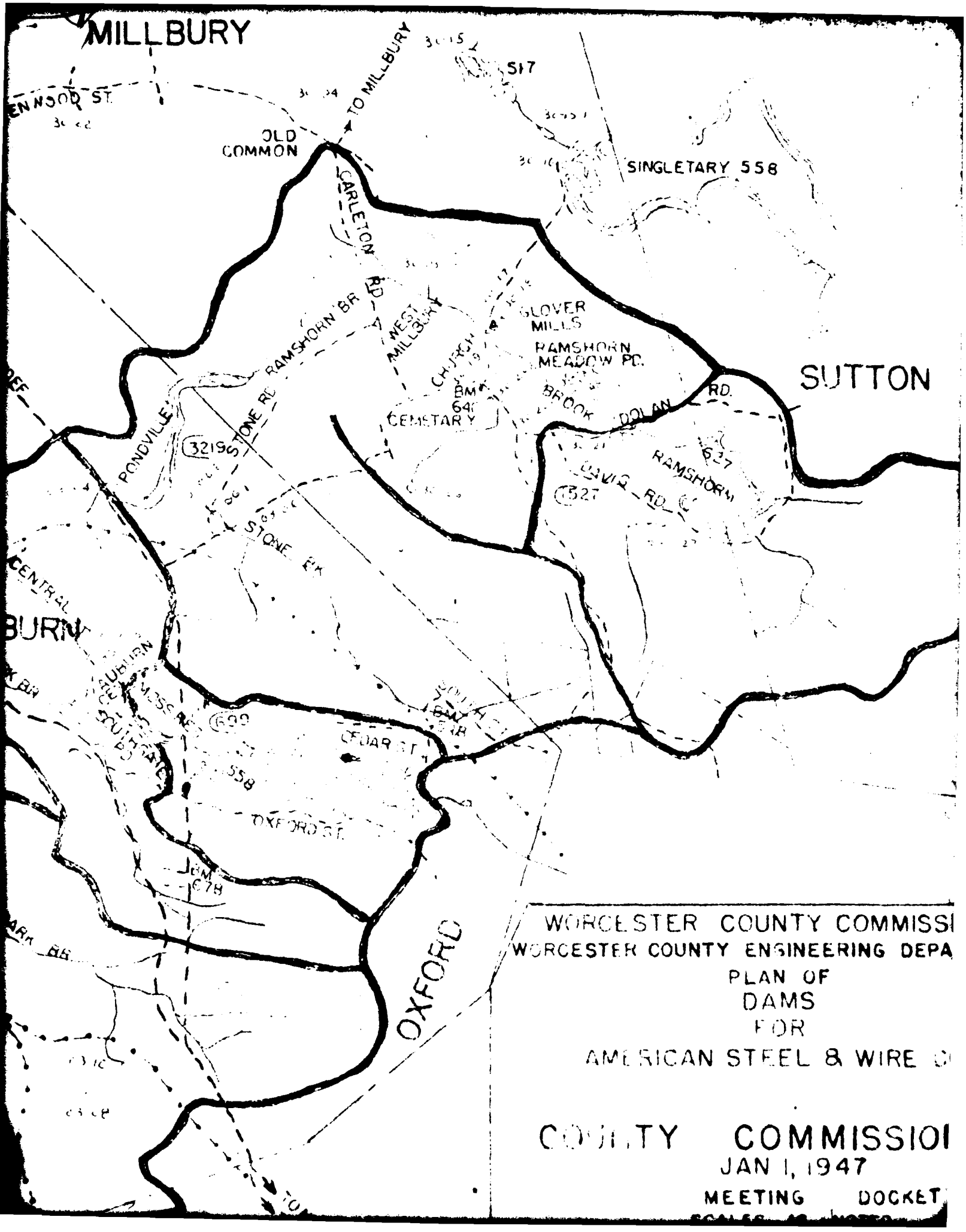
WATER SHEDS HAVING RUN OFF IMPONDED BY WORC. RES.



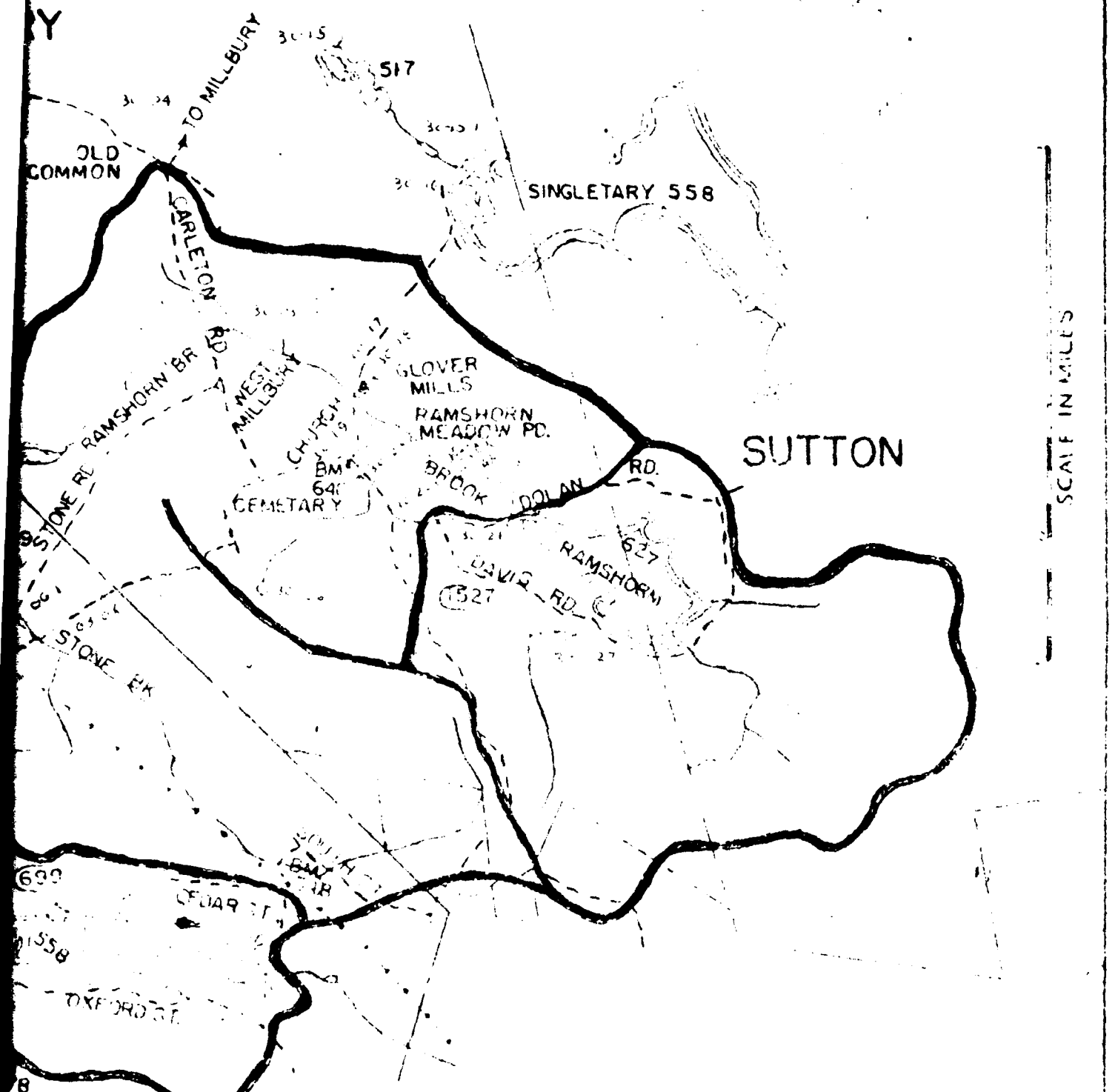


DEN
SALISBURY ST
PLEASANT
COES RES
CHANDLER ST
PATCH RES
COOKS
BROOK
TATNUCK SQ
TATNUCK
HOLDEN RES
NO 2
728
3373
752
OLEON ST
MOWER ST
SMITHS
MILL ST
4229
SILVER SPRING BR
ASNEBUMSKIT
LYNDE BR
989
SOUTHWICK
MULLBERRY ST
SYLVESTER ST
LYNDE BRK RES
824
1861
LYNDE BR
WORS SPIN
ING & FINN
ING CO
449
848
824
NO 1
EARLE ST
WAITE
821
MAIN ST
RESERVOIR ST
NO 2
BR
NO 3
KETTLE
1042
1896
NO 4


MILLB
SOUTH WORKS
BALLARD ST
GREENWOOD ST.
GREENWOOD ST
MILLBURY ST
CAMBRIDGE ST.
SOUTHBRIDGE ST
McKEON RD.
986
MAIN ST
WHITTALL
STILLWATER
CEMETERY
HOPE AVE
SOUTHWEST CUTOFF
WORC. RENDERING WORKS
PONDVILLE
WORC ELEC
WEBSTER ST
LEESVILLE PDS.
1522
CURTIS
CITY WIER
472
883
BOYLE ST.
KETTLE BR
R.R. STATION
1347
498
CENTRAL
HILTON
AUBURN
AUBURN ST
QUEENSBURY COMBING CO
DARK BR
WORC WIRE
SO LUDLOW ST.
OXFORD ST
527
515
STONEVILLE
4870
LUDLOW KETTLE
G F WRIGHT S.&W.CO.
GEO E. DUFFEY MFG.
DOBE BEV. ELFSKIN CORP
STAFFORD ST
692
RICHDALE ST.
568
STONEVILLE RES.
1772
CHERRY VALLEY
ONLEYS
FINNISH
WEST BR
DARK BR
MAIN ST.
1/2


MILLBURY
TO MILLBURY
OLD COMMON
CARLETON
SINGLETARY 558
GLOVER MILLS
RAMSHORN MEADOW PD.
WEST MILLBURY
CHURCH
CEMETARY
BM 64
RAMSHORN BR RD
PONDVILLE
STONE RD
SUTTON
DOLAN RD.
BROOK
RAMSHORN
DEVIL RD
CENTRAL
STONE RD
CEDAR ST
OXFORD ST
OXFORD
WORCESTER COUNTY COMMISSI
WORCESTER COUNTY ENGINEERING DEPA
PLAN OF
DAMS
FOR
AMERICAN STEEL & WIRE
COUNTY COMMISSIOI
JAN 1, 1947
MEETING DOCKET

1 SHEET



WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
DAMS
FOR
AMERICAN STEEL & WIRE CO

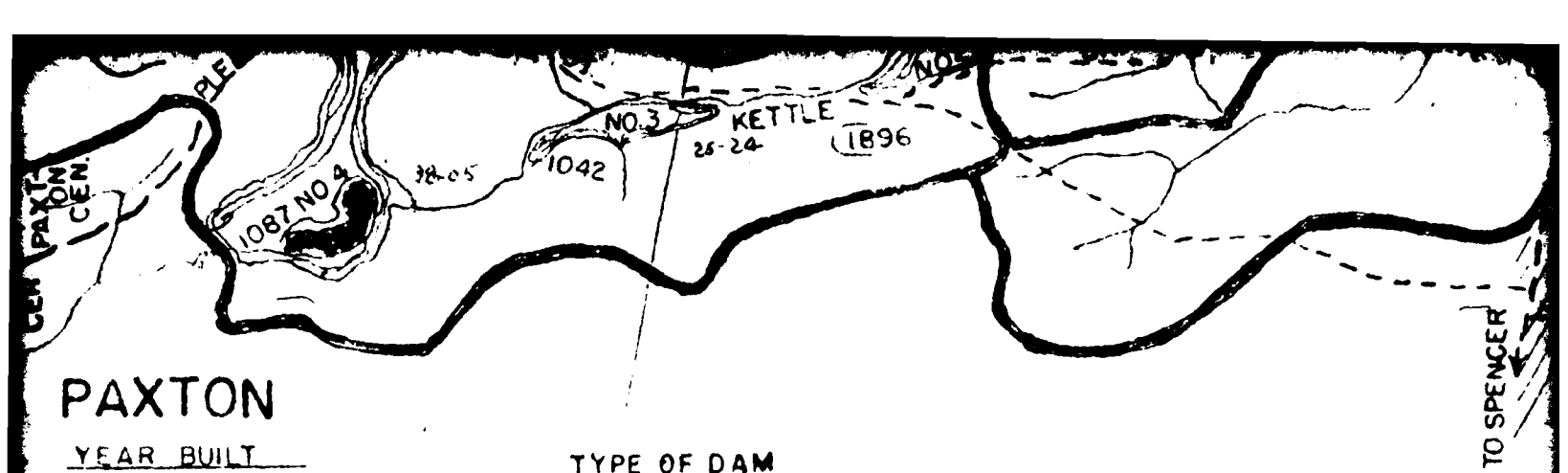
COUNTY COMMISSIONERS

PAXTO

	POND NAME	CAPACITY OF POND IN MILLIONS OF GAL	AREA OF POND IN ACRES	INDIVIDUAL WATERSHED IN ACRES	TOTAL WATERSHED IN ACRES	ELEV. OF TOP OF DAM SPILLWAY	ELEV. OF TOP OF FLASHBOARDS	YEAR BU ORIGINAL DAM	PR D
61-02	CENTRAL WORKS *	5.3	5.3			443.40		1814	
61-06	COES RESERVOIR *		119		4229				
61-05	CURTIS POND *	160	62	883	10663				
03-03	HILTON POND	40	26.4	1247	6732	96.56	98.38		
61-15	LEESVILL POND	125		1522	15780				
03-05	MOSS RESERVOIR	256	158	699	699	110.79	112.17	CONCRETE EA 1921	
03-04	PONDVILLE POND	1.25	45	2639	4746				
30-21	RAMSHORN POND	720	148	1527	1527	22.0	24.0	PREVIOUS TO 1831	
30-21	RAMSHORN MEADOW POND	22	38	580	2107				
61-03	STILL WATER POND *	35	30	605	24319				
03-01	STONEVILLE POND		45	4870	7466				
03-02	STONEVILLE RESERVOIR	185	68	1772	1772				
03-07	SOUTHGATE POND	1.5	1.5	83	782				
61-01	SOUTH WORKS POND *	20.0	13.0	381	24700	438.04	440.04		

* RUN OFF FROM WATERSHED EFFECTED BY CITY STREETS AND STORM SEWERS PLAN

NOTE: THE INFORMATION SHOWN ON THIS PLAN WAS DRAWN EXISTING PLANS, & F
PARTICUARLY THE G.E. GOODRICH REPORT NOV. 14, 1921 AND "MOSS RESE



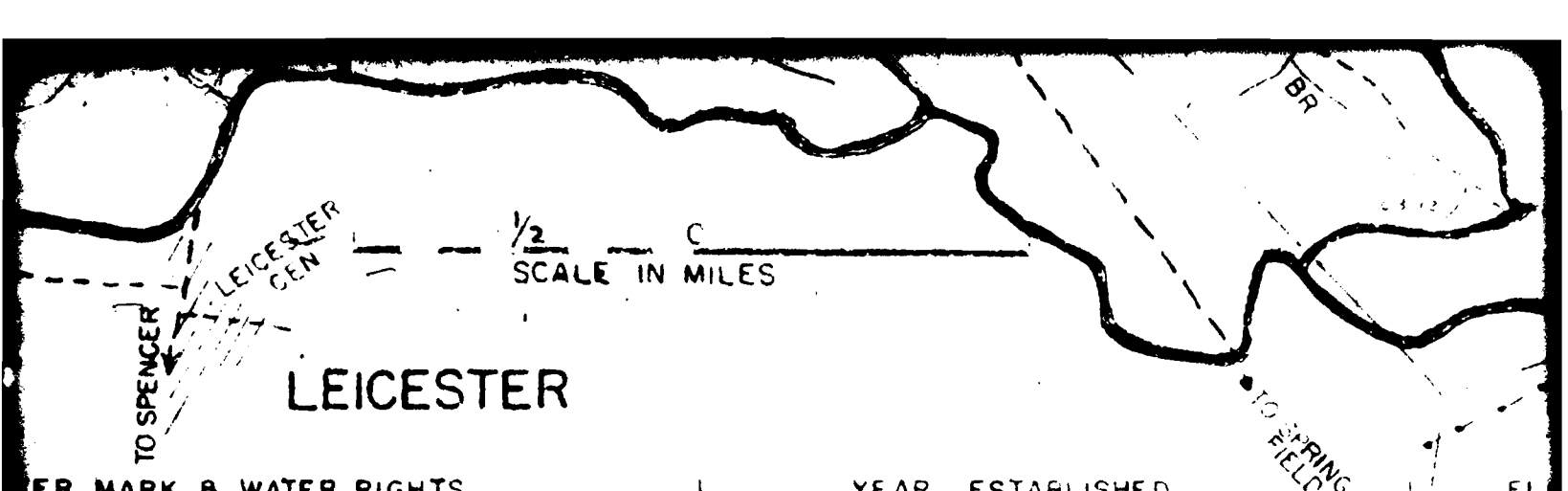
PAXTON

YEAR BUILT ORIGINAL DAM	YEAR BUILT PRESENT DAM	TYPE OF DAM	HIGH WATER MARK
1814	1899	EARTH MASONARY TIMBER CORE PLAN B 177 1899 REPAIRS 1936 PLAN 12718	ELEV 443.47 COPPER BOL SOUTH OF AND 153' W FRO 3646 - BOUND IS SHOWN A WAY. PROP PLAN - 8038
			ELEV. 473.51, TWO FEET BE OF SPILLWAY. WORCESTER
	1932	GATE IS SCREW STEM 24" PIPE EARTH WITH CONCRETE CORE WALL PLAN FOR CORE- WALL SC 42 - CONCRETE SPILLWAY PLAN 13530 - 31 10591 REPAIRS	WATER RIGHTS PURCHASE PAGE 293 PROPERTY PLAN 8034
CONCRETE 1921	EARTH ADDED 1928	CONCRETE GRAVITY SECTION, COVERED WITH EARTH GATE SCREW STEM, 30" x 30" BOX OUTLET	ELEV. 112.05 BRASS PLUG IN SOUTH OF SPILLWAY CREST 8044 A FOR PARCILS PURC
		STONE MASONARY	
PREVIOUS TO 1831	10' ADDED 1872-3	GATE SCREW STEM, 24" ϕ OUTLET PIPE (POSSIBLY) 30" EARTH PUDDLED 10' EITHER SIDE CHESTNUT CUTOFF WALL ALONG DAM & (1873) PLAN 13515 A & B	ELEV. 24.29' IRON PIN IN LEDGE OF N.W. COR. OF N W. BRIDGE
	1916	GATE 36" ϕ OUTLET EARTH WITH CONCRETE COREWALL, CONCRETE SPILLWAY PLAN 7171	PROPERTY MAP 8033
		RACK, PINON ? CONCRETE ?	PROPERTY MAP 8769 (1S
			PROPERTY MAP 8769 (190
		GATE 30" ϕ OUTLET EARTH & STONE WALL	FROM M. BONZEY 1917 BK. 2
	1891	FLOOD GATE - RACK & PINION, INTAKE GATE - SCREW STEM INSTALLED IN 1943 - MASONARY, PLAN 3955 INTAKE 14454 A-H SECTIONS THU. POND 3265 (1906) 12792 (1936)	ELEV. 443.47 SAME AS CE ESTABLISHED IN EXCHANGE CROSS, AM. S. & W. CO. CI P.F. & F. W. TAYLOR PROP.

RS PLANS FOR MOSS RES. DAM: CONCRETE, ORIGINAL DAM 8510 TO 12, PRES CONST. 10584, 10582-
PROPERTY, 1877, 8044A & LOTS PURCHASED IN CEDAR SWAMP 8771

NS, & FROM FILES OF SUPT. OF ENG. & MAINT.

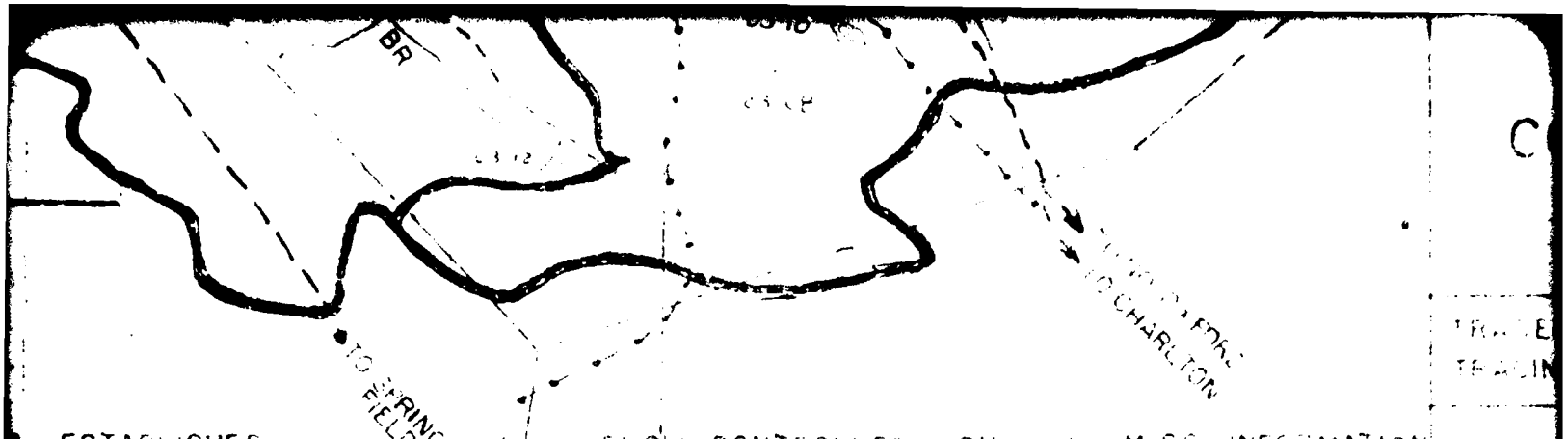
S RESERVOIR" DATA CONCERNING ORIGINAL OWNERS OF CEDAR SWAMP



LEICESTER

ER MARK & WATER RIGHTS	YEAR ESTABLISHED	FL
OPPER BOLT TOP OF STONE BOUND 11.5 S3' W FROM S.E COR OF MILL. FROM PLAN S SHOWN AS 60' UP STREAM FROM SPILL - AN - 8038	1873 BY SUPERIOR COURT DEGREE VOL. 22 P. 127. WASHBURN MOEN MFG. CO. VERSUS CROMPTON CARPET CO. DEFENDANT	AMERICA
		NO AGRE
0 FEET BELOW BOLT IN EAST CONCRETE WALL RCESTER ELECTRIC LIGHT PLAN # 1336 PURCHASED 1917 FROM HILTON HEIRS BK 2123	JAN 30, 1914 BY H.A. PRATT PRIV. ENG	NEW ENG AM S & W IN EMER
N 8034 HIGH WATER MARK		AMERICA
		CONSOLI
PLUG IN LEDGE, EAST SIDE OF POND, 208' Y CREST PLANS 14628 - SEE PLAN CILS PURCHASE - ALSO 8771 - 8777	OCT. 21, 1924 BY COUNTY COMM	AMERICA LAREE F WE HAVE
N IN LEDGE ON WESTERLY SHORE ELEV. W. BRIDGE WING WALL - 30.00	1872 REG. OF DEEDS, BK. 875, P132-149 PURCHASED BY A. CURTIS AS TRUSTEE FOR RAMSHORN POND CO. PREVIOUS TO RAISING DAM	RAMSHOR WORC CO CO. CONS EL ON BL
8033		(AM S & W. WIND
		WHITTAL CALL EN
769 (1904)		GUEENS NEW EN PURCH
69 (1904)		
7 BK. 2123, P. 290		AMERIC
ASCENTRAL WORKS) HANGE OF TITLES BETWEEN HOLY CO. CITY OF WORCESTER AND PROP. PLAN 8041.	AP. 29, 1909 BK. 1904, P. 68 THIS IS (TAYLOR DEED)	AMERICA
10562-3, 10507 & S10400, S14628) 8771		

THIS DRAWING AND ALL INFORMATION TH
AND IS CONFIDENTIAL AND MUST NOT BE
AND IS SUBJECT TO RETURN UPON DEM



ESTABLISHED	FLOW CONTROLLED BY	MISC. INFORMATION
RIOR COURT DEGREE VOL. 22 URN MOEN MFG CO. VERSUS PET CO. DEFENDANT	AMERICAN STEEL & WIRE CO.	
	NO AGREEMENT - COES CO.	
BY H.A. PRATT PRIV. ENG.	NEW ENG. POWER ASSOCIATES AM S&W CO. CAN OBTAIN WATER IN EMERG.	OLDEST WATER PRIVILAGE IN ELEC. LIGHT CO. USES 2 MIL. GAL FOR CONDENSING, POND KEPT
	AMERICAN STEEL & WIRE CO.	
	CONSOLIDATED RENDERING CO.	NECESSARY TO KEEP POND FU OF THEIR PUMPS
BY COUNTY COMM.	AMERICAN STEEL & WIRE CO.	DURING SUMMER MONTHS RES OF WATER WITHOUT DRAW D
	LAREE FABRICS MILLS INC. WE HAVE NO AGREEMENT	USED FOR CLEANING & CONDEN NO POWER USE
EEDS, BK. 875, P132-149 A. CURTIS AS TRUSTEE FOR D CO. PREVIOUS TO RAISING DAM	RAMSHORN POND ASS. - A.S & W. CO. WORC. COUNTY ELEC. HOPEVILL MFG. CO. CONSOL. RENDERING WHITTALL EL. ON BLACKSTONE RIVER AM S & W. CO. DAY CLOVER, W. WINDLE	MIN. FLOW REQ BY SMALL MILLS WE R - 2,500,000 GAL. DAY PRO 1939 NEVER HAS EXCEEDED 10 USED FOR IMPONDING DURING RA IN WINTER TO ENABLE CLOSING O HORN POND GATE
	WHITTALL ASSOCIATES CALL ENG RM FOR FLASH BD CHANGE	USED FOR POWER WHEN PLENTY WATER OTHER USE IS FOR CLEA
	GUEENSBURY COMBING CO NEW ENGLAND POWER ASSOCIATES PURCHASED IN 1945	THE AGREEMENT IS THAT GUEENSB COMBING CO. CAN DRAW SUFFICIE WATER TO R. PLANT WE CAN O WATER BY CONSULTING N.E. POWE
	AMERICAN STEEL & WIRE CO.	DAM WASHED OUT
K, 1904, P. 68. THIS IS	AMERICAN STEEL & WIRE CO.	18,700,000 GAL. PER DAY REQ FOR SOUTH WORKS & WIRE MIL AS MEASURED IN 1942 PREPARI TO INTAKE CHANGES

DAM NOS. AS N

AMERICAN STEEL & WIRE CO

COUNTY COMMISSIONERS

JAN 1, 1947

MEETING DOCKET

SCALES AS NOTED

TRACINGS PREPARED BY

TRACINGS CHECKED BY W.O.

DAM NO.

BY	MISC. INFORMATION
	COUNTY ENGINEER
S VATER	OLDEST WATER PRIVILAGE IN SYSTEM, WORC. COUNTY ELEC. LIGHT CO USES 2 MIL. GAL. 24 HRS (1921) FOR CONDENSING, POND KEPT FULL
D.	NECESSARY TO KEEP POND FULL FOR SUCTION OF THEIR PUMPS
D.	DURING SUMMER MONTHS RESERVOIR LOSES 2" OF WATER WITHOUT DRAW DOWN
W. CO MFG. TALL	USED FOR CLEANING & CONDENSING PURPOSES NO POWER USE MIN. FLOW REQ BY SMALL MILLS WHEN IN OPERATION IS 6" THRU 36" WIRE WE R - 3,500,000 GAL. DAY FROM H.W. CLOVER, FLOW FROM 1904 TO 939 NEVER HAS EXCEEDED 10" OVER SPILLWAY
HANGE	USED FOR IMPONDING DURING RAINS & IN WINTER TO ENABLE CLOSING OF RAMS HORN POND GATE USED FOR POWER WHEN PLENTY OF WATER OTHER USE IS FOR CLEANING
CIATED	THE AGREEMENT IS THAT QUEENSBURY COMBING CO CAN DRAW SUFFICIENT WATER TO R. PLANT WE CAN OBTAIN WATER BY CONSULTING N.E. POWER CO
D.	DAM WASHED OUT
	18,700,000 GAL. PER DAY REG. FOR SOUTH WORKS & WIRE MILL AS MEASURED IN 1942 PREPARITORY TO INTAKE CHANGES

TY OF THE AMERICAN STEEL & WIRE COMPANY
ED UNLESS AUTHORIZED BY THEM

AMERICAN STEEL & WIRE CO
SUBSIDIARY OF
UNITED STATES STEEL CORPORATION

ENGINEERING DEPARTMENT USS

WORCESTER MASS

DRAWN BY JAN. 1, 1947, BROUGH

SCALE 1" = ½ MILE

17720

WATER SHED OF SOUTHWORKS POND

DAM NOS AS NOTED ON PLAN

WATERSHED PLAN

Project Nat. Review of Non Fed. Dams Acct No 5864 Page 1 of 6
Subject Worcester, Mass. Area Compld By LEB Date 7/26/78
Detail QUINSIGAMOND RES. DAM Ck'd By [illegible] Date [illegible]

(I) Peak Inflow Test Flood & 100 Year Flood & Storage Functions

A- Inflow Test Flood

Use "Leesville" Curve, adjusted by reduction factors due to area exceeding 10 mi²

Drain Area = 51.7 mi², P.F.R. (Leesville) = 850 cfs./mi²

[Ref. Fig 16 - "Design of Small Dams" - U.S.B.R. - for Zone 1]

Leesville - 32.1 mi² - reduction factor = 88%

Quinsigamon - 51.7 mi² - " " = 82%

Due to low dam use 50% of final value

Remove 6000 cfs diversion from final value

$Q_A = \frac{1}{2}(850)(51.7)\frac{82}{.88} - 6000 = 14,475$ cfs $= Q_A$

Alternate Method for Verification (prev. report values)

Peak Coes outflow	- 10.9 mi²	- Max Q =	8500
" Leesville "	- 32.1 "	" " =	8700
*Remaining 8.7 sq mi	— 8.7 "	" " =	2600
	51.7 "		19800 c.f.s. $= Q_A$

*This Value = 2x Millbrook Drain Cap. x $\frac{8.7 \text{ mi}^2}{11.3 \text{ "}}$
with Millbrook taken at 1675 cfs from M&E Report & Factor of 2 for overland flow under extreme storm conditions

Ave Q_A & Q_A for Inflow Test Flood = 17140 cfs (331.5 c s.m.)

B - 100 Year Test Flood (use prev. report values)

100 yr disch. from Coes	— 3080
" " - Leesville	— 234
Remaining Area: $1.2 \times 1675 \times \frac{8.7}{11.3}$	— 1547
	4860 cfs = 100 Year St. Inflow
	(94.0 c.s.m.)

C - Storage Functions

1- Inflow Test Flood.

$Q_{Final} = Q_{in}\left(1 - \frac{S_{Final}}{9.5''}\right)$; $F_{TF} = 17140 - 1804\ S$

2- 100 yr. Flood: $F_{100} = 4860 - 1034.5\ S$

S = inches on watershed equal to reservoir storage $= 12D\frac{.102}{51.7} = .00464\ D$
where D is Storage Depth on Reservoir in feet

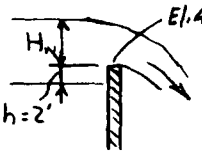
METCALF & EDDY, ENGINEERS

Project Nat. Review of Non Fed. Dams Acct No 5864 Page 2 of 6
Subject Worcester Mass Area Compld By LEB Date 7/26/78
Detail QUINSIGAMOND RES. DAM Ck'd By RW Date 8/7/78

(II) Discharge & Storage Function vs Pond Elev.

A - Weir

Narrow stone weir. Silt level to top of weir along most of its length. Assume high flood flows will erode 2' of silt behind weir. Length of weir 152.2' (use chord length)



$C_w = 3.27 + 0.4 \frac{H_w}{h}$ in $q_w = C_w H_w^{3/2}$

B - Crest (Overland) Flow

Assume no sizeable "Crest" flow until pond reaches elev. 447.5. This is due to R.R. tracks just down stream. Use 270' length for crest flow up to elevation 450 based on Broad crested weir relation:

$q_c = 2.55 (H_c)^{3/2}$; $H_c = H_w - 6.5$; $Q_c = 688.5 H_c^{1.5}$

C - Totals

Pond Elev	H_w	C_w	q_w	Q_w L=152.2	Q_c	Q_{Tot}	S	F_{TF}	F_{100}
442	1	3.47	3.47	528	—	528			
443	2	3.67	10.38	1580	—	1580			
444	3	3.87	20.11	3060	—	3060	.014		4846
445	4	4.07	32.56	4956	—	4956	.018		4840
446	5	4.27	47.74	7267	—	7267	.023		
447	6	4.47	65.70	10000	—	10000			
448	7	4.67	86.5	13165	243	13400	.032	17081	
449	8	4.87	110.2	16772	1265	18000	.037	17073	
450	9	5.07	136.9	20836	2721	23600	.042		

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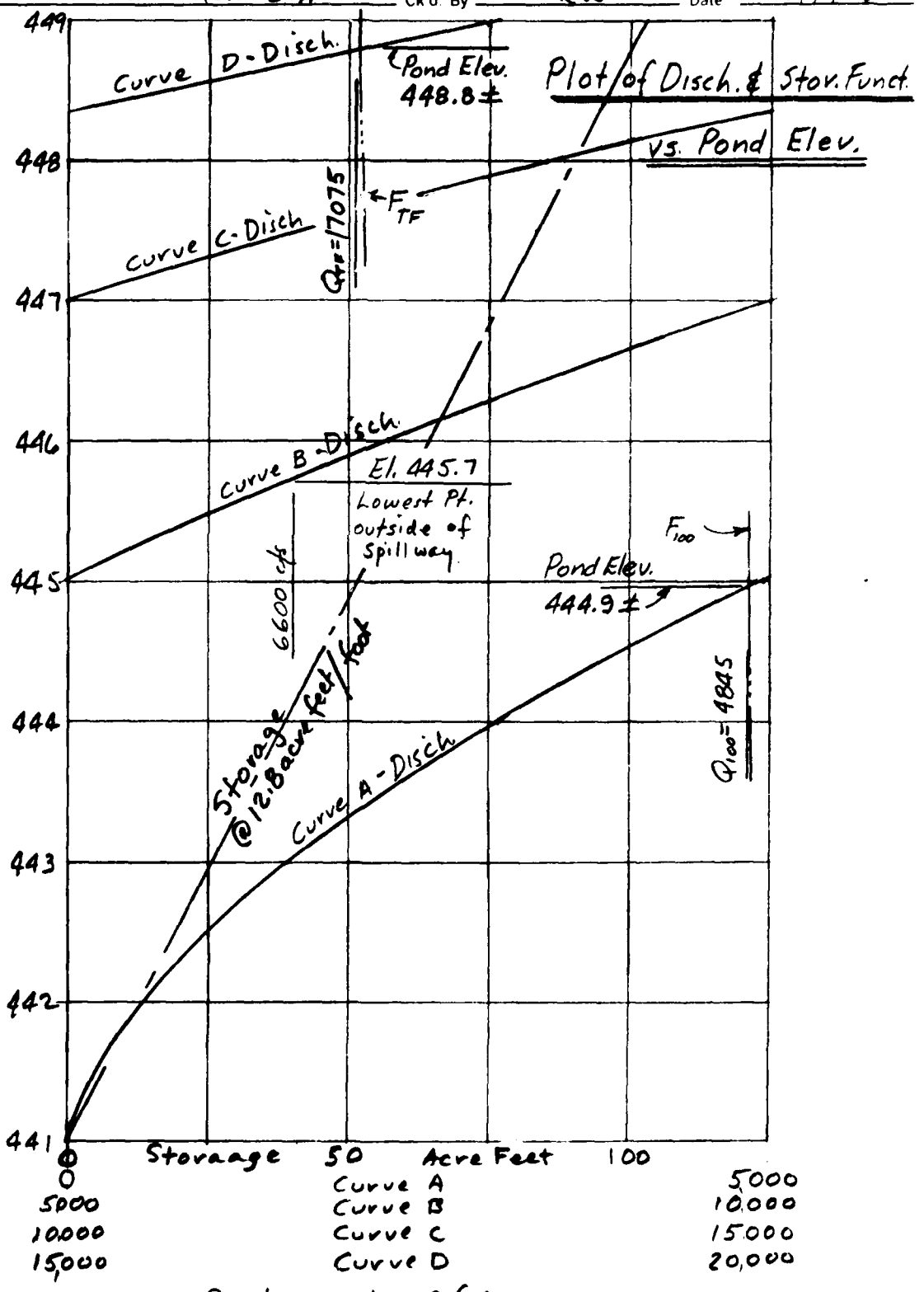
(III)



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(IV) Failure of Dam - A- Failure With Pond @ Weir Elev.

Peak Failure Flow:

Pond Elevation - 445.7
Toe Elevation — 433.0 ±
Y_o = 12.7

Dam Length Subject to Breaching = 152' (Mainly Spillway)

$W_o = 40\%(152) = 61'$

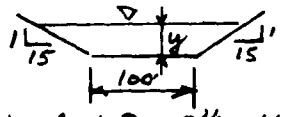
$Q_{P_1} = 1.68\, W_o\, (Y_o)^{1.5} = 1.68(61')(12.7)^{1.5} =$ 4640 c.f.s.

Spillway Disch. 6600 cfs ; T.W. Depth 5.5', Area = 1004 ft²; Q_1 = 11240 cfs

Storage Volume Released:

Storage Above Spillway : From Graph = 83
Storage Below Spillway . 2 (.02) 640 = 26
S = Total Storage = 109 acre ft.

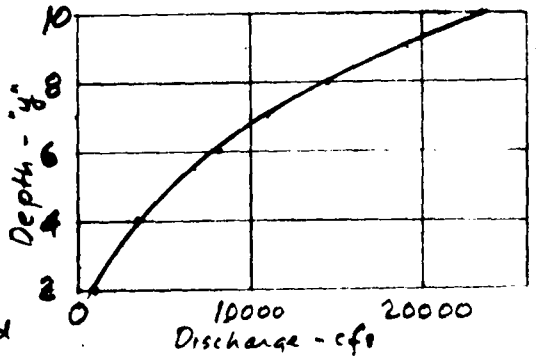
Channel Hydraulics: $S = \frac{10}{1800} = .00555$; $n = .04$



$A = y(100 + 15y)$; $P \simeq B = 100 + 30y$

$V = 2.78\, R^{4/3}$

y	A	P	$R^{4/3}$	V	Q
2	260	160	1.382	3.84	999
4	640	220	2.038	5.67	3626
6	1140	280	2.550	7.09	8081
8	1760	340	2.990	8.32	14641
10	2500	400	3.393	9.43	23582
12	3360	460	4.933	12.32	41407



1st Reach : 400' to bldg. @ Channel bend

$Q_1 = 11240$; $y_1 = 7.1'$; $A_1 = 1466$; $\Delta Vol_1 = 4.2$ ac ft.

$Q_2 = 11240\left(1 - \frac{4.2}{109}\right) = 10800$ cfs ; Wave Ht. $\simeq 7.0'$

Say $Q_{Final} = 11000$ cfs., $y \simeq 7.0'$, $\Delta TW = 1.5'$

Time to Drain:

$$\frac{43560\,(109)}{3600\,(\tfrac{1}{2})\,(4640)} = 0.57 \text{ Hours} = 34 \text{ Min}$$

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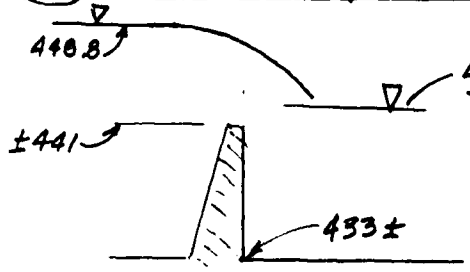
IV Failure of Dam (cont.)

B - Failure Under Peak Flow:



Prior to Failure

The only major section of this dam likely to fail under high flows is the 152' of weir section. Prior to failure at peak flows this section discharges at 105.2 cfs/ft

The failure of a section of the weir would result in a discharge of:

$Y_o = 448.8 - 441.7 = 7.1'$; $Q_{P_1} = 1.68(7.1)^{1.5} = 31.8$ cfs/ft

Total Failure Flow:

$Q_T = 17075 + 61(31.8) = 19000$ cfs

Tailwater would rise from 8.7' depth to 9.0' depth due to dam failure during peak Test Flood outflow

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(V) Summary of Resulting Flows

A. Inflow Test Flood

Peak Outflow 17075 c.f.s. @ Pond El. 448.8 (330 csm)

Peak Spillway Flow = 16055 cfs

Peak Overland (Crest) Flow = 1020 c.f.s.

Unit Overland Flow = $\frac{1020}{270}$ = 3.78 cfs/ft

Critical Depth = 0.76 ; Critical Vel. = 5.0 fps.

Tailwater El. (approx.) = 8.0' + 433 = 441.0

B. 100 Year Flood

Peak Outflow 4845 c.f.s. @ Pond El. 444.9 (94 csm)

No Appreciable Overland (Crest) Flow

Tailwater Elev. (approx.) = 4.5' + 433 = 437.5

(VI) Outlet Capacity

Length is short - treat as orifice 4.75' x 3' wide

Inv El. 433.4 , Pond El. 441.0 , Head = 7.6' , $H/D = \frac{7.6}{4.75} = 1.6$

Q = 3 x 50 = 150 cfs. (2.9 c.s.m.) [with Pond @ Dam Crest El]

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APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
MA	159	NED	MA	027	03				QUINSIGAMOND POND DAM	4214.1	7147.8	06	SEP	78

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	QUINSIGAMOND POND

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	06	BLACKSTONE RIVER	WORCESTER	0	172300

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE–FT.)	(27) IMPOUNDING CAPACITIES NORMAL (ACRE–FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REGNPG	1891	R	18	18	180	100	NED	N	N	N	N	8SEP78

(28) REMARKS

(29) O/S HAS	(30) SPILLWAY LENGTH (FT.)	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (CFS)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
1	240	U	155	6600	2100											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
RILEY STOKER COMPANY	J W ELLIS	UNKNOWN

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(50) INSPECTION BY	(51) INSPECTION DATE DAY	MO	YR	(52) AUTHORITY FOR INSPECTION
METCALF + EDDY, INC.	03	AUG	78	PUBLIC LAW 92-367

(53) REMARKS